Roads and Traffic Authority of NSW

Oxley Highway to Kempsey
Upgrading the Pacific Highway

Environmental Assessment

MAIN VOLUME

September 2010

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ISBN: 978-1-921766-49-7

PART B – THE PROPOSAL

6. The Proposal

This chapter provides a detailed description of the Proposal and outlines the development of the concept design. It also includes plans of the Proposal and its design elements.

The Director-General's environmental assessment requirements require a detailed description of the Proposal. **Table 6-1** indicates where the aspects of the Director-General's environmental assessment requirements that relate to the description of the Proposal are addressed, either in this chapter or in other chapters (in *italics*).

Table 6-1 Detailed description of the Proposal

Environmental assessment requirements	Where addressed
A **detailed description** of the Project including:	**Section 6.3**
• Route alignment and corridor width.	**Sections 6.3** and **6.4.1**
• Design elements (e.g. requirements for LOS, pedestrian and cyclists, rest areas and service centres etc).	**Sections 6.1** and **6.4**
• Differentiate the limits of the Project with respect to the existing Pacific Highway, including operational/ maintenance responsibilities.	**Sections 6.3** and **6.4.1**
• Potential staging.	*Chapter 7 Construction of the Proposal*
• Ancillary facilities (e.g. compound site, batching plants etc).	*Chapter 7 Construction of the Proposal*
• Resourcing (e.g. construction material needs, spoil disposal, natural resource consumption including water).	*Chapter 7 Construction of the Proposal*

6.1 Development of the concept design

The Proposal is based on a concept design, which has been prepared using the best available information and the current design standards for the Pacific Highway Upgrade Program. The details and dimensions of the concept design are indicative only and would be subject to further refinement as a result of the outcomes of the approval process and the availability of additional information during later phases.

As discussed in **Section 3.3.3**, the preferred route represents the best balance of environmental, engineering and social factors when compared with the alternatives. The concept design process further developed the preferred route, taking into account specific environmental constraints, engineering requirements and community feedback.

The concept design has been developed to meet the Pacific Highway Upgrade Program design parameters as outlined in **Table 6-2**. The design standard used for the Proposal is the RTA's *Upgrading the Pacific Highway - Upgrading Program Beyond 2006 - Design Guidelines* (July 2005a, Issue 2.1). In addition to this standard, the *Road Design Guide* (RTA 1988) and *Austroads' Guide to Traffic Engineering Practice* (Austroads 1998) have also been used.

Table 6-2 Overview of Pacific Highway design parameters

Design parameters	Design objective
Design speed	110 km/h (with the vertical alignment reduced to 100 km/h at specific locations).
Posted speed limit	110 km/h.
Number of lanes	Generally two lanes per carriageway, capable of being upgraded to three lanes per carriageway.
Carriageway type	Dual carriageway.
Access	The upgraded highway is to be controlled access. No direct access to the upgraded highway is provided between interchanges or traffic arrangements. Service road access to the upgraded highway is limited to on- and off-ramps at interchanges or traffic arrangements.
Interchanges	All intersections are to be grade separated. There are to be no cross carriageway vehicle movements at intersections. Full acceleration and deceleration lengths to be provided.
Alternative routes	Alternative route provided through the construction of service roads or local arterial road networks.
Maximum vertical grade	4.5 per cent desirable. 6.0 per cent absolute maximum.
Vertical clearance to overhead bridges	5.5 m desirable. 5.3 m absolute minimum.
Design vehicle	19.5 m semi-trailer / 25 m B-double.
Flood immunity	Minimum of one carriageway flood free for the 20 year flood events and desirable for 100 year flood events.

The concept design confirms the feasibility of upgrading this section of the Pacific Highway to a motorway standard, and determines the extent of property acquisition requirements and forms the basis of the environmental impact assessment.

Elements of the Proposal could be further amended and refined through the detailed design process as delivery details are developed. As a result, the performance of both the environmental elements, and the Proposal as a whole, would be further improved.

Figure 6-1a and **Figure 6-1b** summarise the key features of the Proposal.

Figure 6-1a Key features of the Proposal - Sections A and B

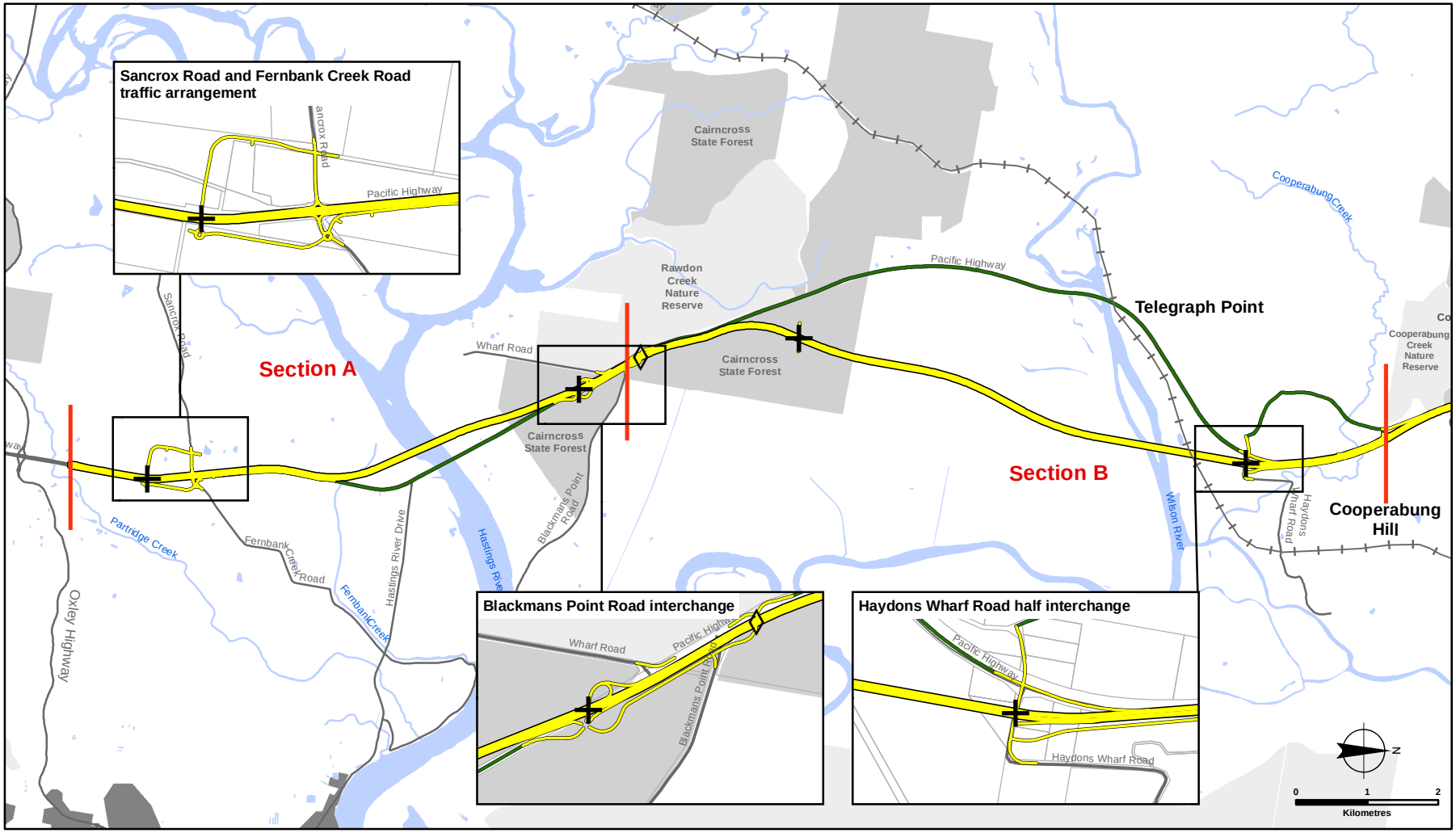
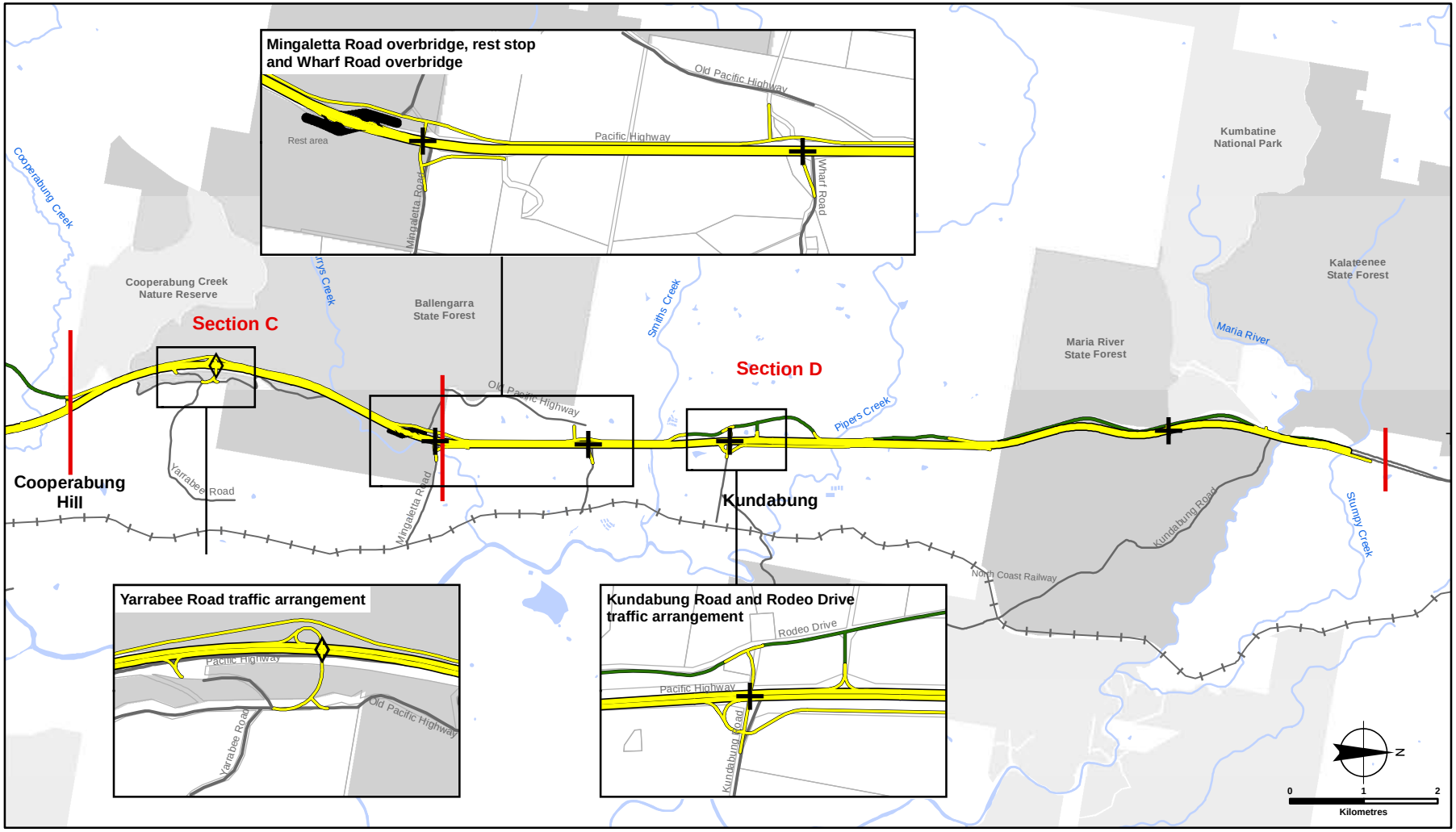


Figure 6-1b Key features of the Proposal - Sections C and D



While the Proposal is for a four-lane motorway standard road throughout, the construction and opening of Proposal could be staged. Staging options could include sections C and D initially being constructed and opened as a four-lane arterial standard road. Further details on staging options for the Proposal are provided in **Section 7.3**. Key features of the arterial standard design compared with the motorway standard are described in **Table 6-3**. Design criteria for service and access roads are described in **Section 6.4.5**.

Table 6-3 Key features of arterial and motorway standard highway upgrades

Feature	Arterial standard	Motorway standard
Posted speed limit	100 km/h (minimum)	110 km/h
Access	There would be some interchanges but property access and local roads could still intersect with the upgraded highway at-grade as left-in / left-out only.	No direct access to the upgraded highway is provided between interchanges or traffic arrangements. Service road access to the upgraded highway is limited to on and off-ramps only at interchanges or traffic arrangements.
Intersections and Interchanges	Entry to and exit from the upgraded highway could be via at-grade intersections, but generally no right turns would be allowed.	All entry to, exit from and crossings of the upgraded highway would be via grade separated interchanges or traffic arrangements.
Alternative routes	A continuous alternative route would not be available.	A continuous alternative route would be available with a desirable design standard of 80 km/h where possible.
U-turn facilities	There would be some U-turn facilities provided upstream and downstream of at-grade property access and local road intersections.	No U-turn facilities provided.
Emergency crossover facilities	Combined emergency crossover/U-turn facilities provided generally as per design guidelines.	Combined emergency crossover/U-turn facilities provided generally as per design guidelines.

6.2 Overview of the Proposal

The general features of the Proposal are:

- Approximately 37 kilometres of four-lane dual carriageway (two lanes in each direction) with a wide median to allow a future upgrade to six lanes.
- A new alignment across the Hastings River and Wilson River floodplains and minor realignment within Maria River State Forest.
- 100 year average recurrence interval flood immunity, with the exception of the Wilson River floodplain where the road embankment would be above the 20 year average recurrence interval flood level.
- A bypass of Telegraph Point. Access to and from Telegraph Point would be provided by a new grade separated interchange in the area of Blackmans Point Road south of Telegraph Point and a half interchange in the area of Haydons Wharf Road north of Telegraph Point.
- Overbridges located to the south of Sancrox Road, at Bill Hill Road, Mingaletta Road, Wharf Road, Kundabung Road and Middle Gate Road.

- The existing Pacific Highway near Blackmans Point Road and Yarrabee Road passing under the Proposal.
- Major cuttings through Cooperabung Hill.
- New major bridge structures for the Hastings River and Wilson River crossings, and the crossing of the North Coast Railway to the north of the Wilson River.
- Smaller bridges for a number of creek crossings.
- Provision of two new rest areas south of Mingaletta Road.
- Provision of a service road network using sections of the existing highway, existing local roads and new roads.

A detailed description of the Proposal is provided in **Section 6.3**.

The Proposal could be upgraded to three lanes in each direction in the future when needed. The design of the Proposal incorporates a wide median to allow for the construction of the additional lanes when required, thereby removing the need to widen the corridor at a later date. The provision of additional lanes would be subject to a separate environmental assessment and approval process.

The Proposal provides for a continuous alternative route in the ultimate motorway standard. This would be provided by the service road network, which would comprise sections of the existing highway and existing local roads (Cooperabung Drive, Rodeo Drive and Ravenswood Road). New sections of service and access road would be constructed to link this network together. An overview of the proposed service road network is shown in **Figure 6-1a** and **Figure 6-1b**, while details are shown in **Figure 6-2a** to **Figure 6-2q**.

The Oxley Highway to Kempsey section of the Pacific Highway currently operates at level of service D. As discussed in **Section 3.2**, one of the Proposal objectives is to achieve a level of service C 20 years after opening.

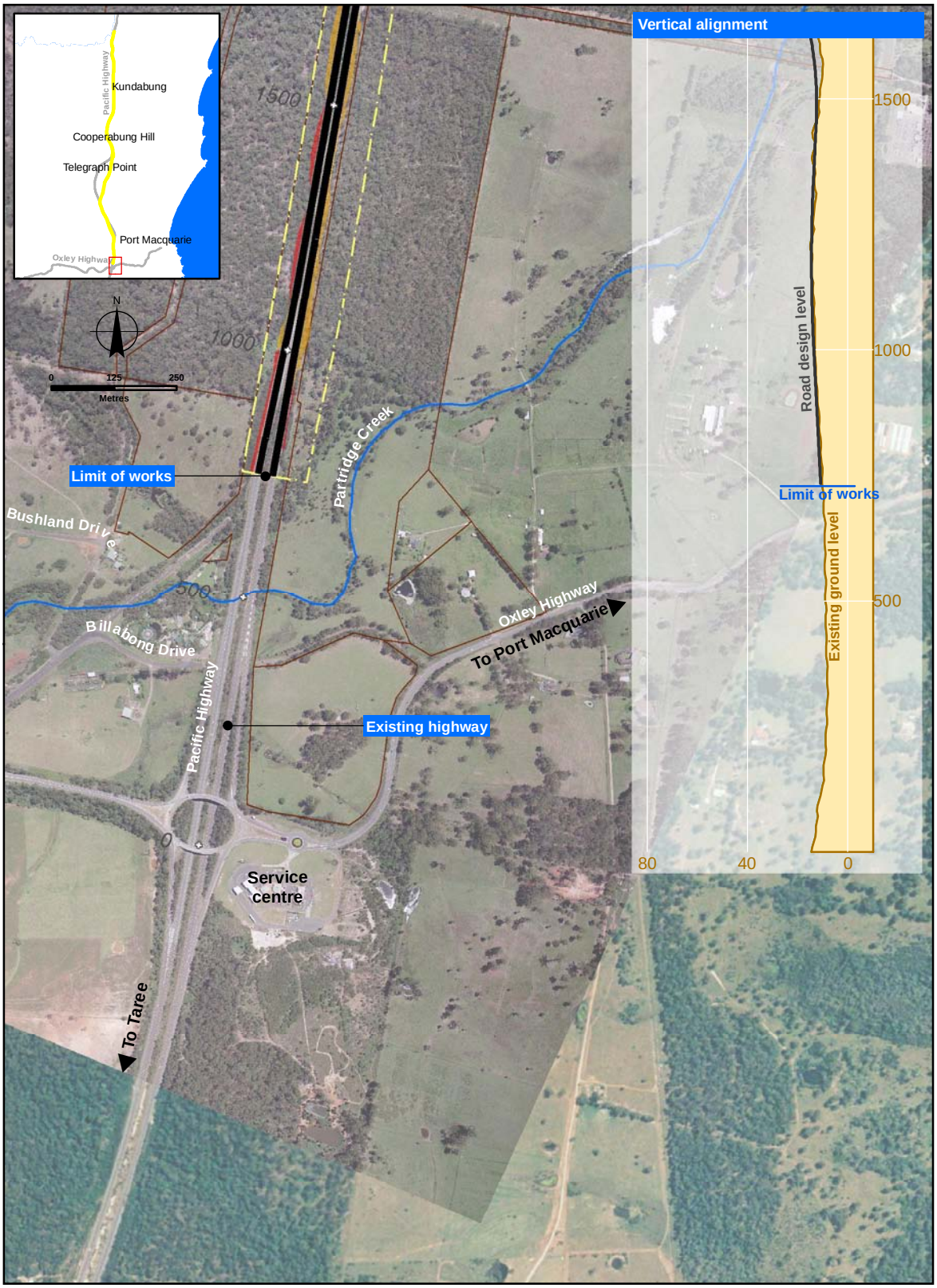
6.3 Detailed description of the Proposal

The following sections provide a detailed description of the Proposal. The Proposal is based on a concept design, which has been prepared using the best available information and the current design standards for the Pacific Highway Upgrade Program. The details and dimensions of the concept design are indicative only and would be subject to further refinement as a result of the outcomes of the approval process and the availability of additional information during later phases.

The Proposal is approximately 37 kilometres in length and may be difficult or expensive to construct and open to traffic as a single work package. The decision on potential construction and operational staging is likely to depend on financial and operational considerations when the funding becomes available. One staging option could be to upgrade Sections A and B (through to Haydons Wharf Road) to the motorway standard, while Sections B (north of Haydons Wharf Road), C and D are upgraded to the arterial standard. The detailed description below presents both the arterial and motorway standard for Sections B (north of Haydons Wharf Road), C and D.

Figure 6-2a to **Figure 6-2q** illustrate the motorway standard only. Further information on staging options is provided in **Section 7.3**.

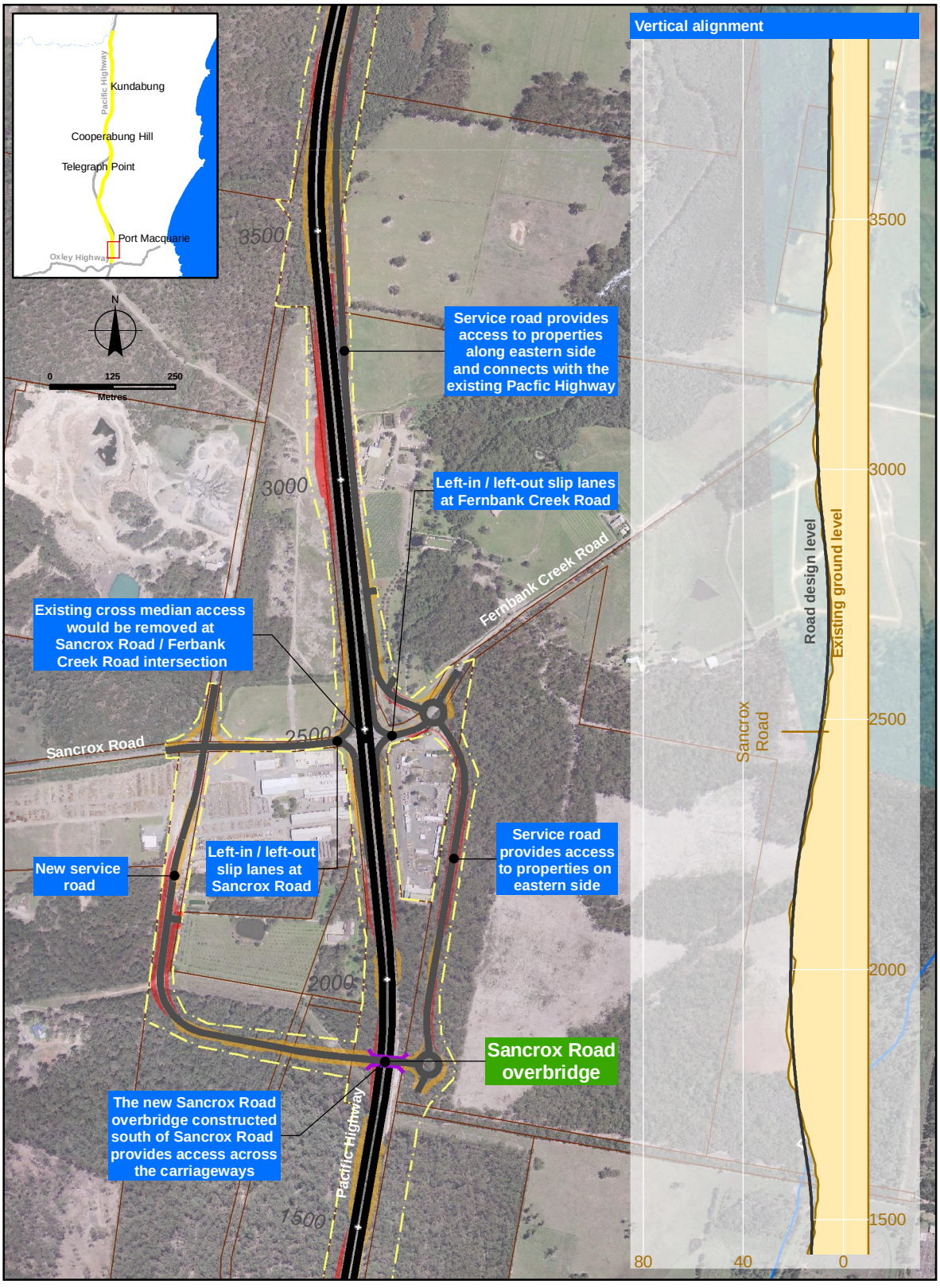
Figure 6-2a The Proposal



The Proposal
Two-lane road carriageway
Road cutting
Road embankment
Proposal Boundary
Cadastre
Watercourse
500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

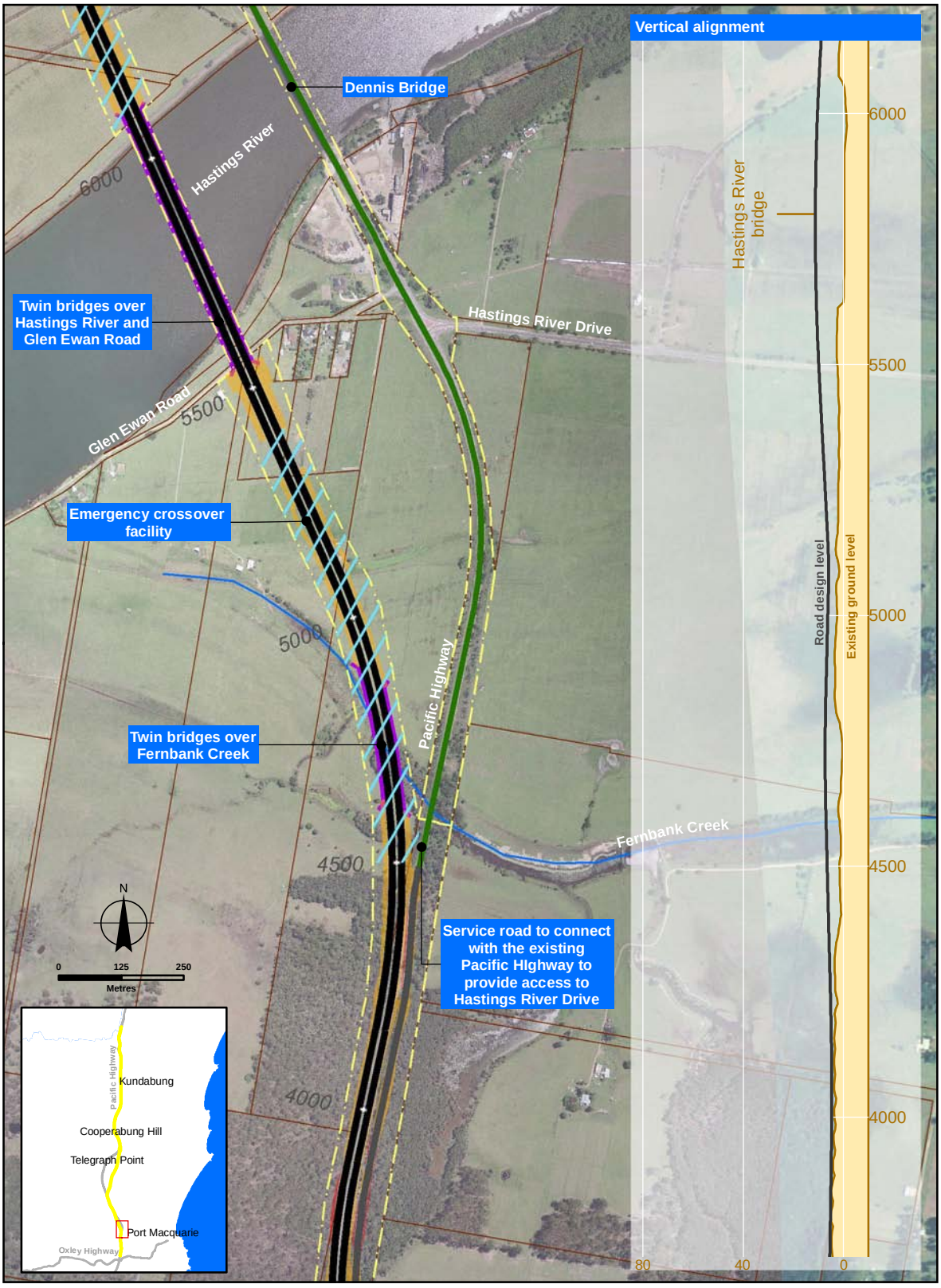
Figure 6-2b The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

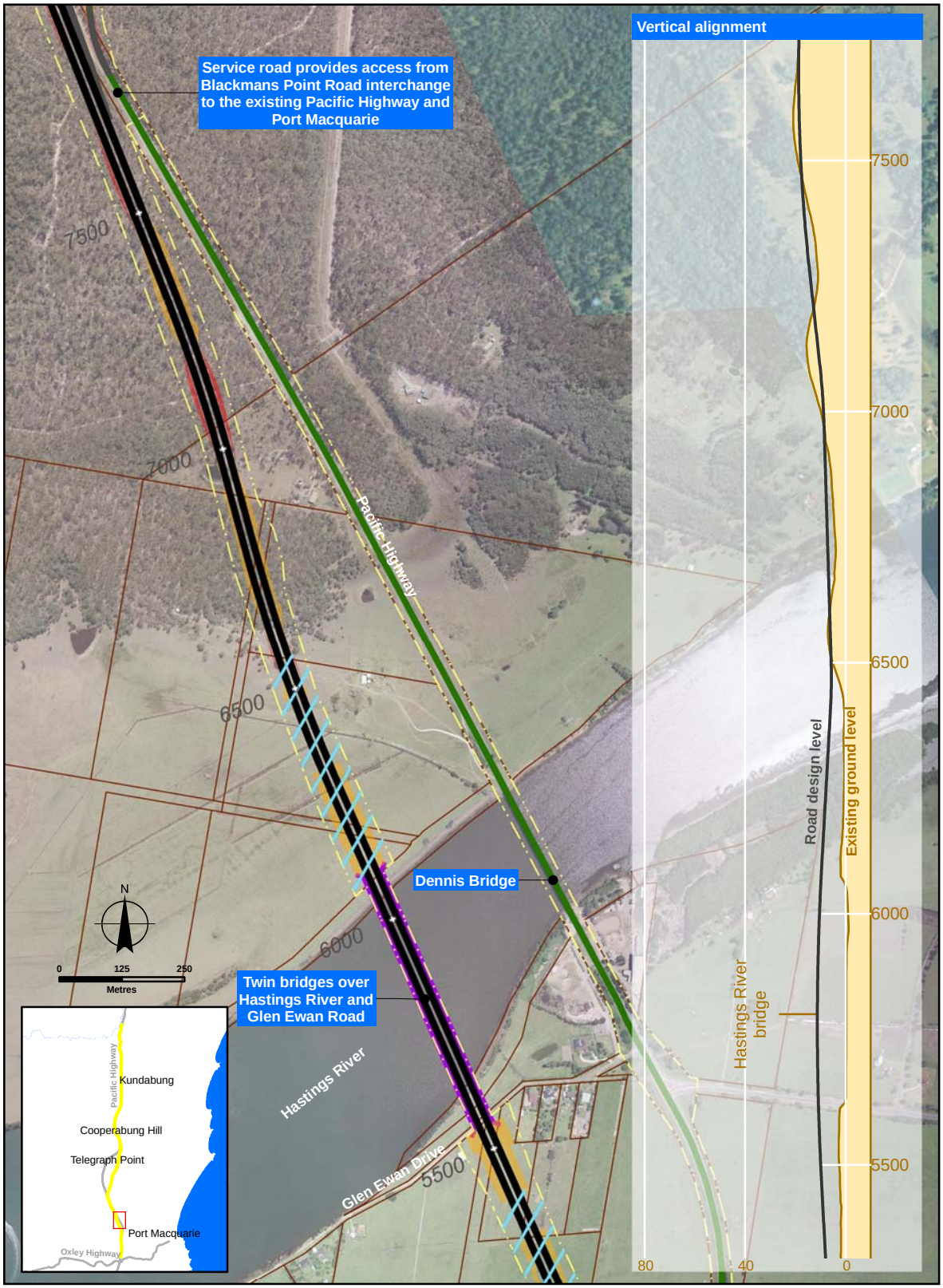
Figure 6-2c The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Indicative location of flood relief structures
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

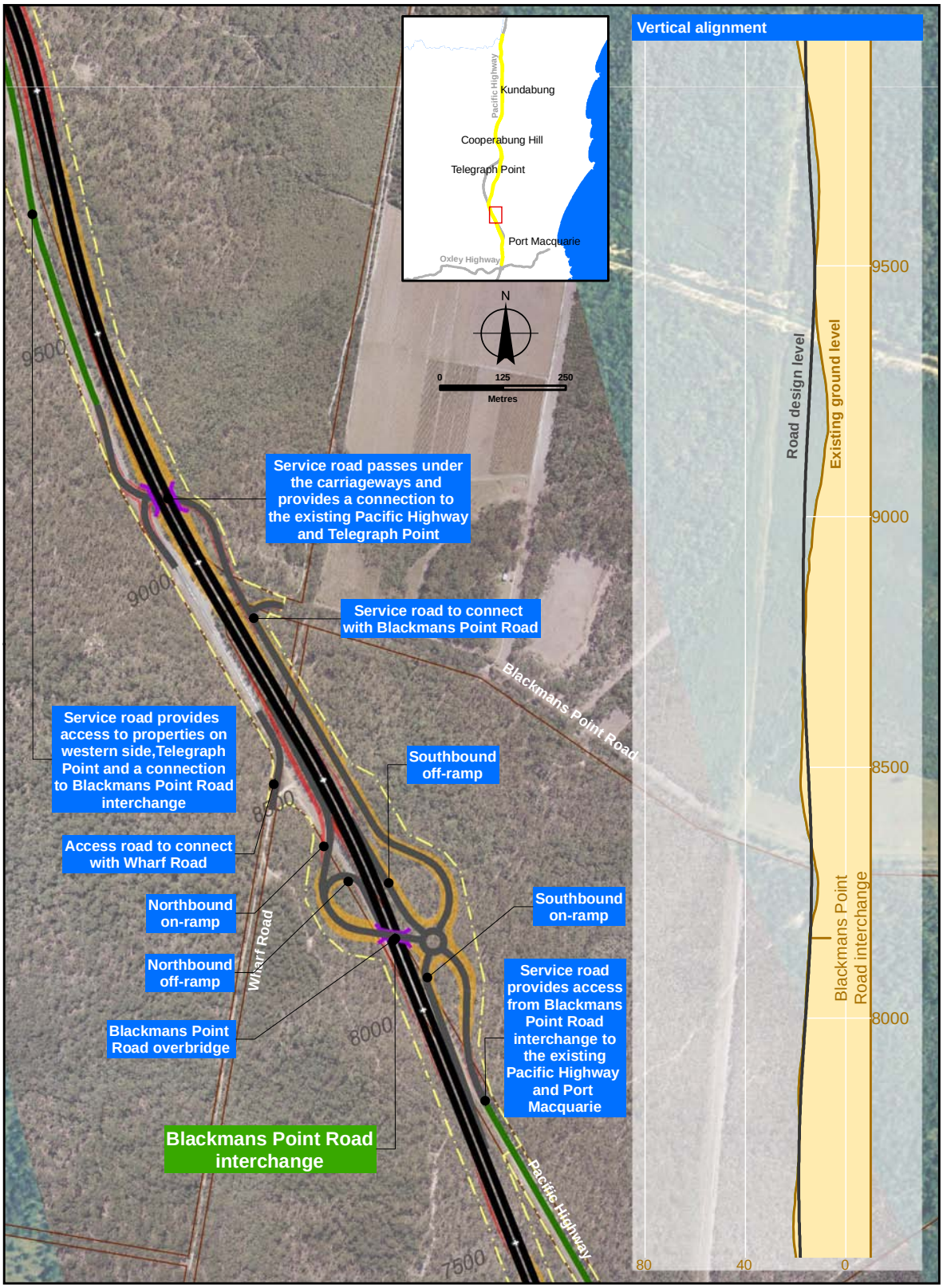
Figure 6-2d The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Indicative location of flood relief structures
- Cadastre
- Watercourse
- +500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-2e The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge

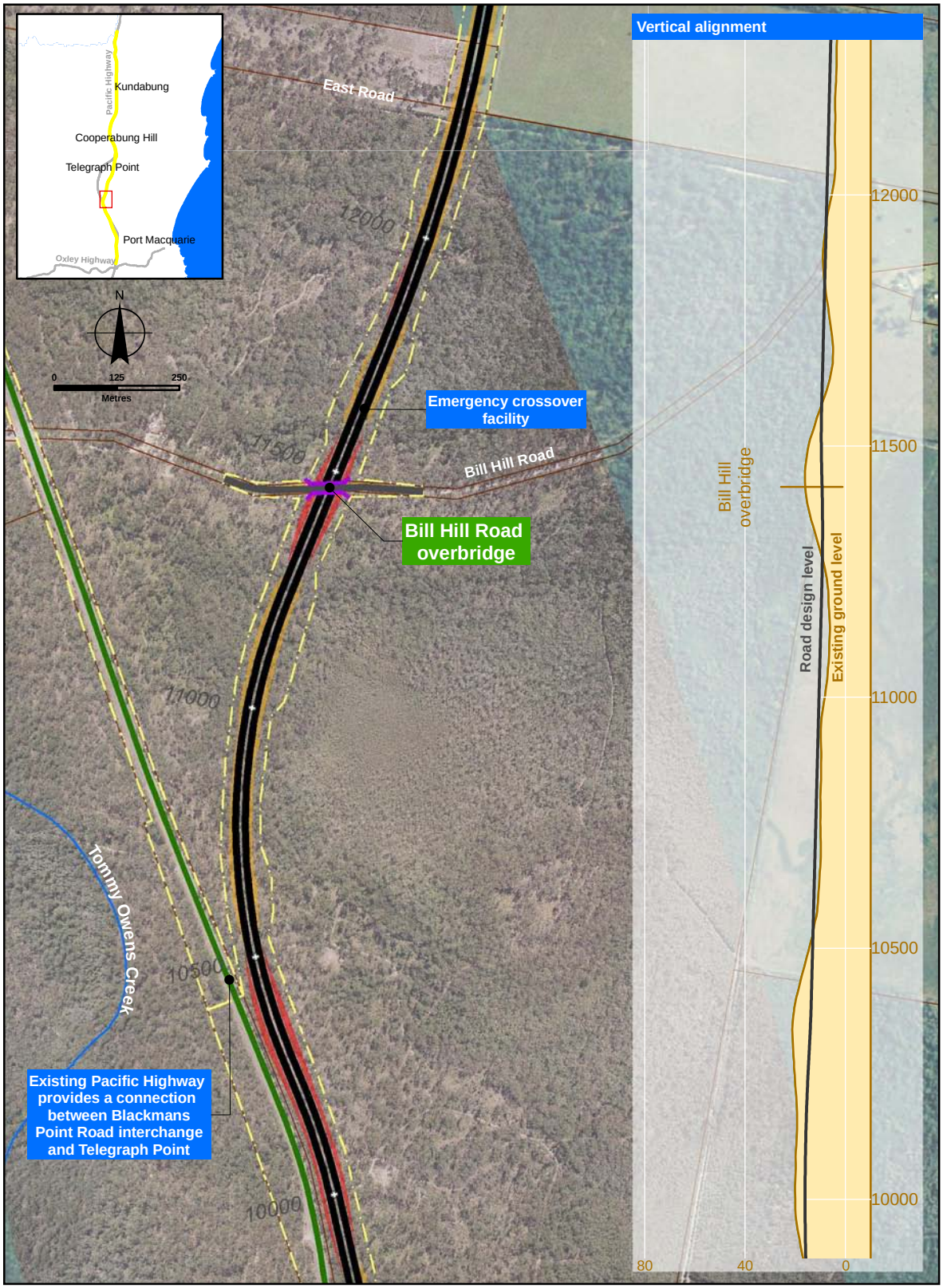
- Road cutting
- Road embankment
- Proposal Boundary

- Cadastre
- Watercourse

500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

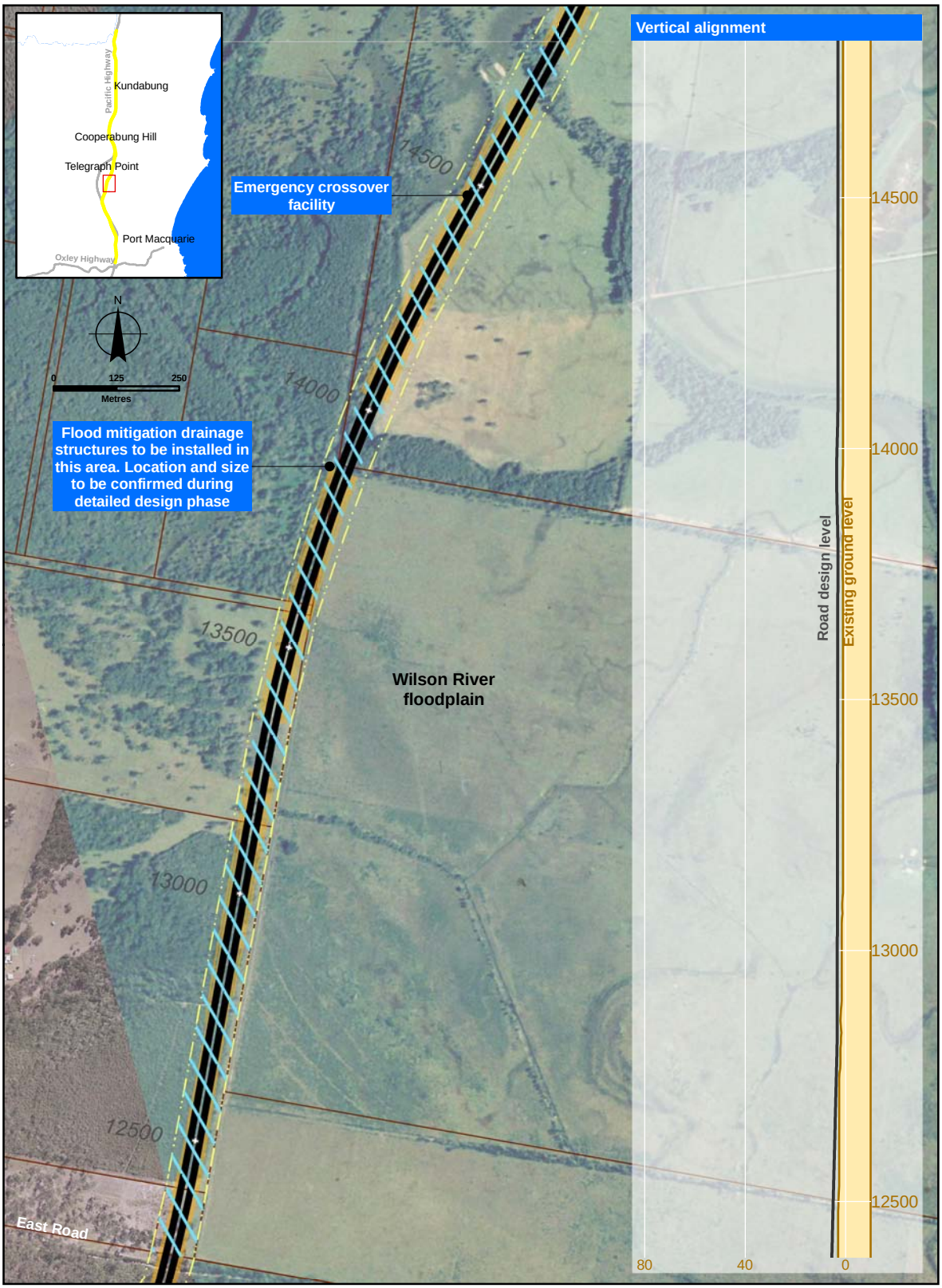
Figure 6-2f The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

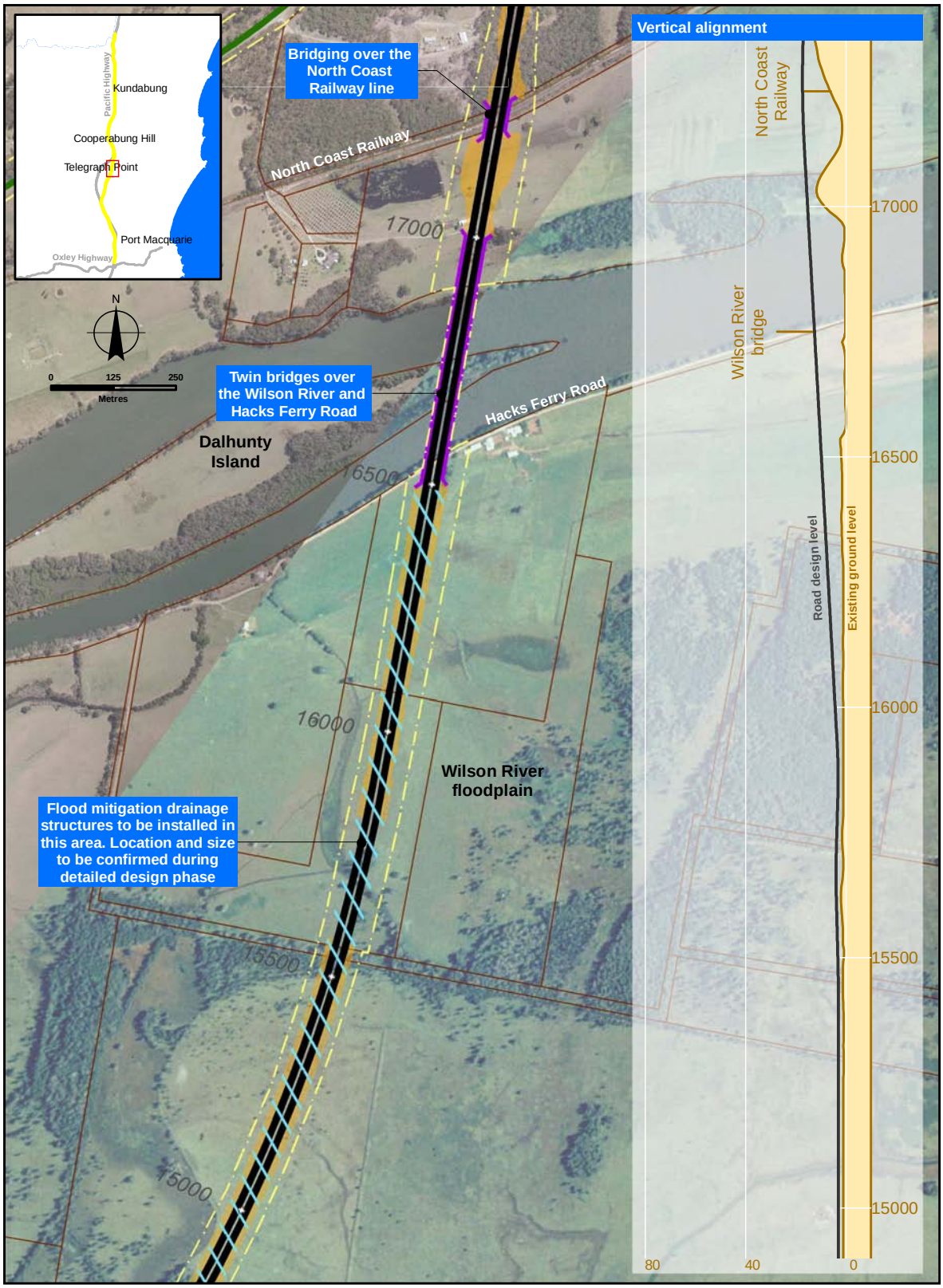
Figure 6-2g The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Indicative location of flood relief structures
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

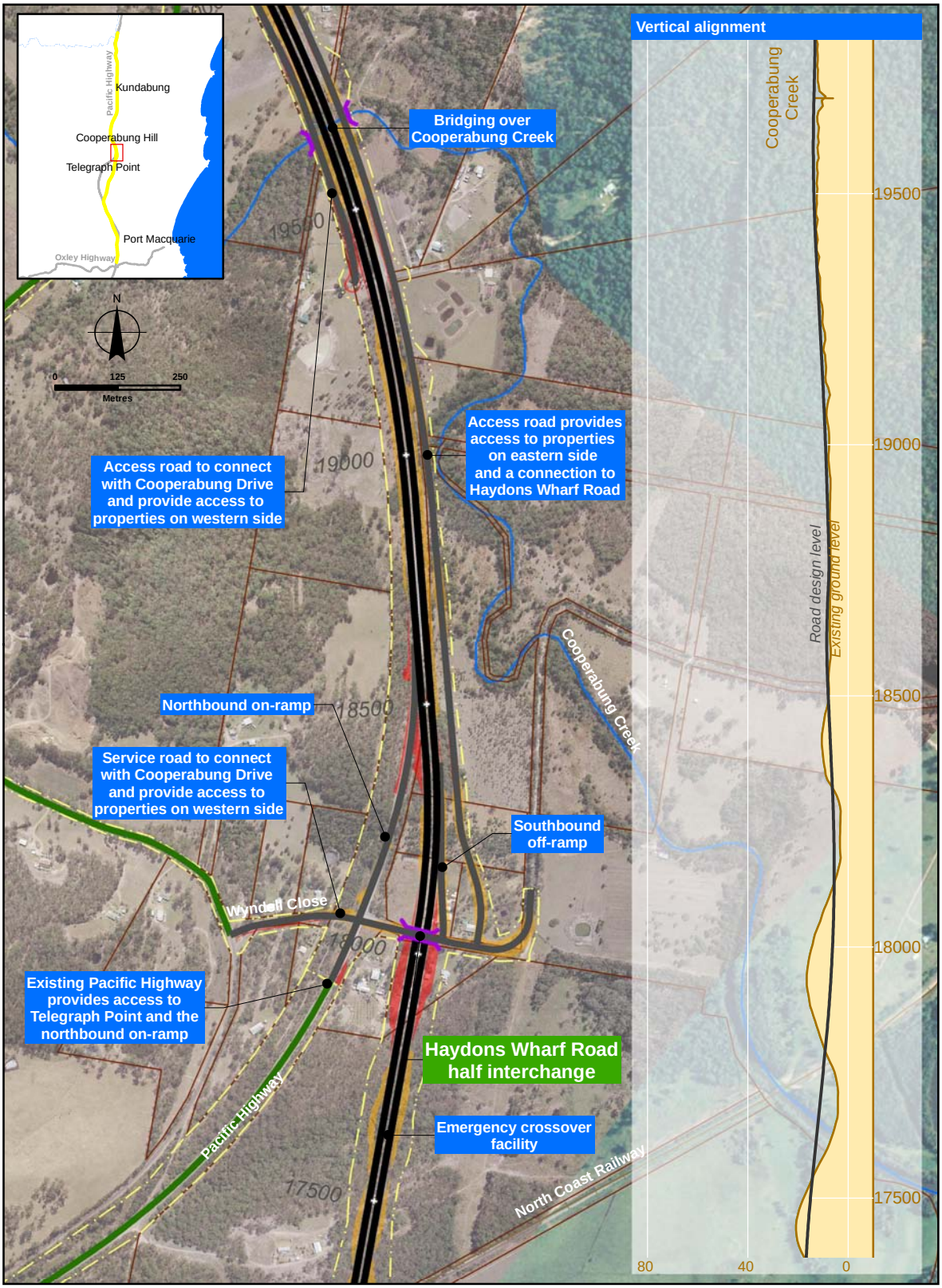
Figure 6-2h The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Indicative location of flood relief structures
- Cadastre
- Watercourse
- Railway
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-2i The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge

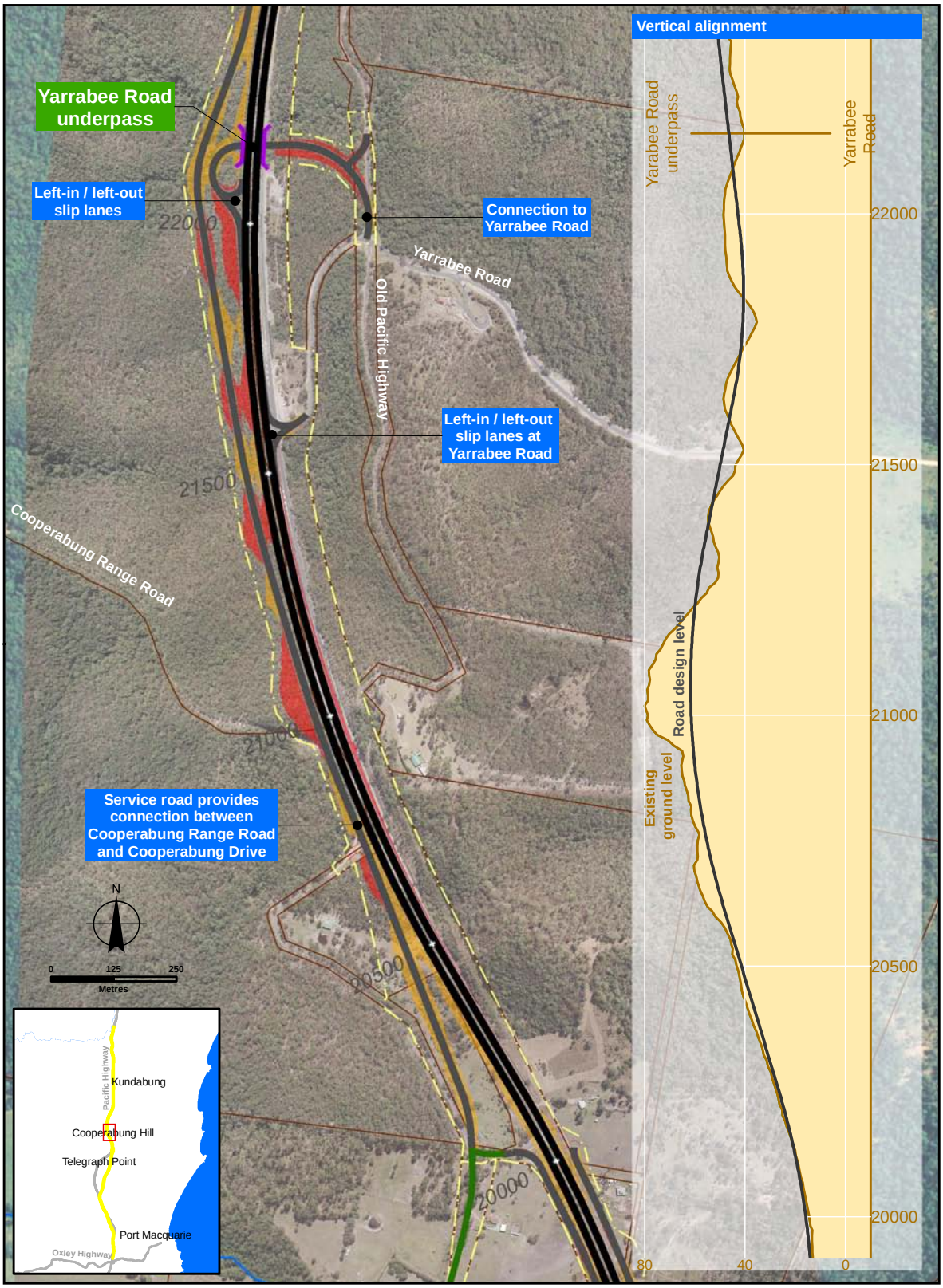
- Road cutting
- Road embankment
- Proposal Boundary

- Cadastre
- Watercourse
- Railway

500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

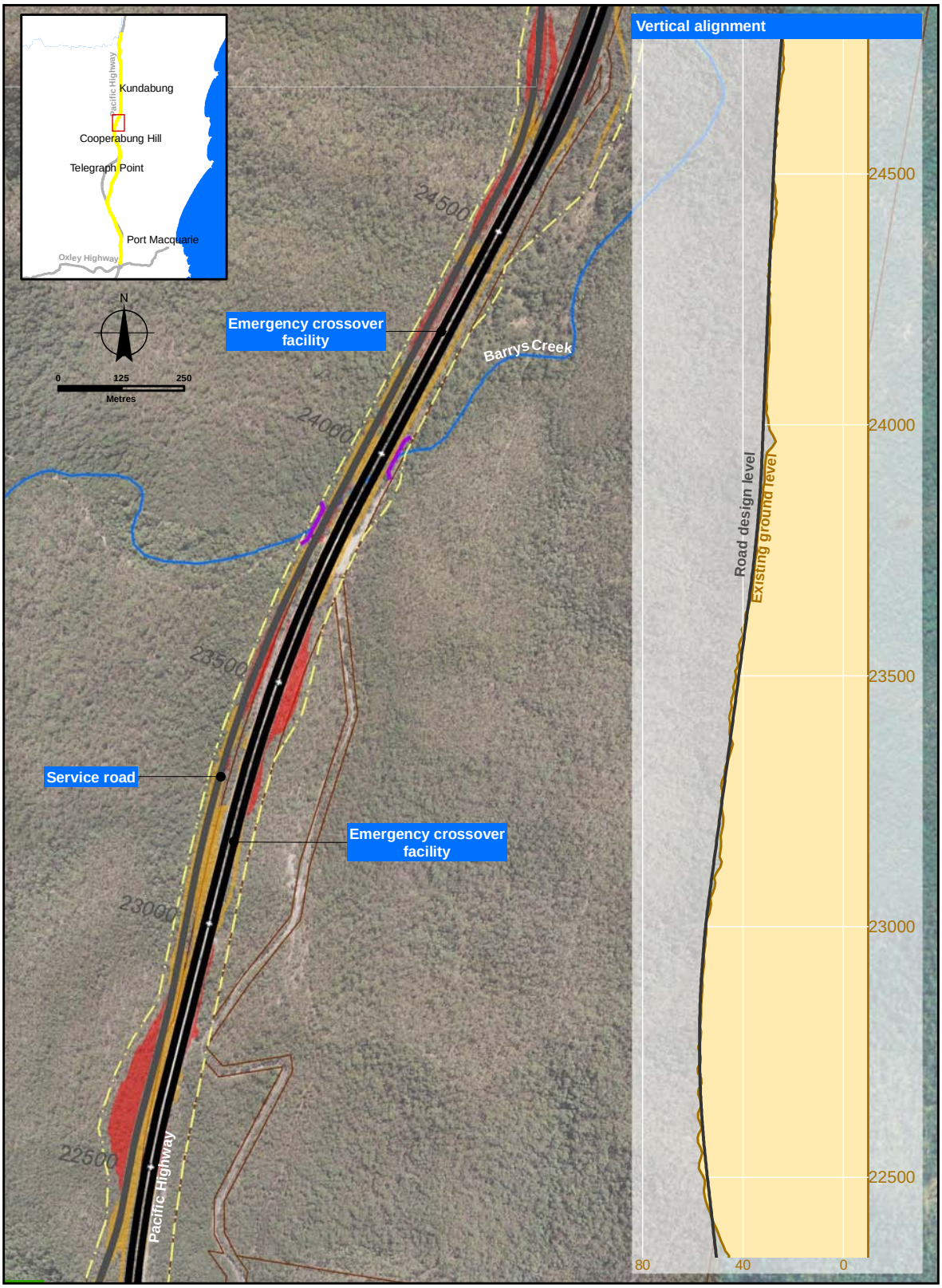
Figure 6-2j The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-2k The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Bridge

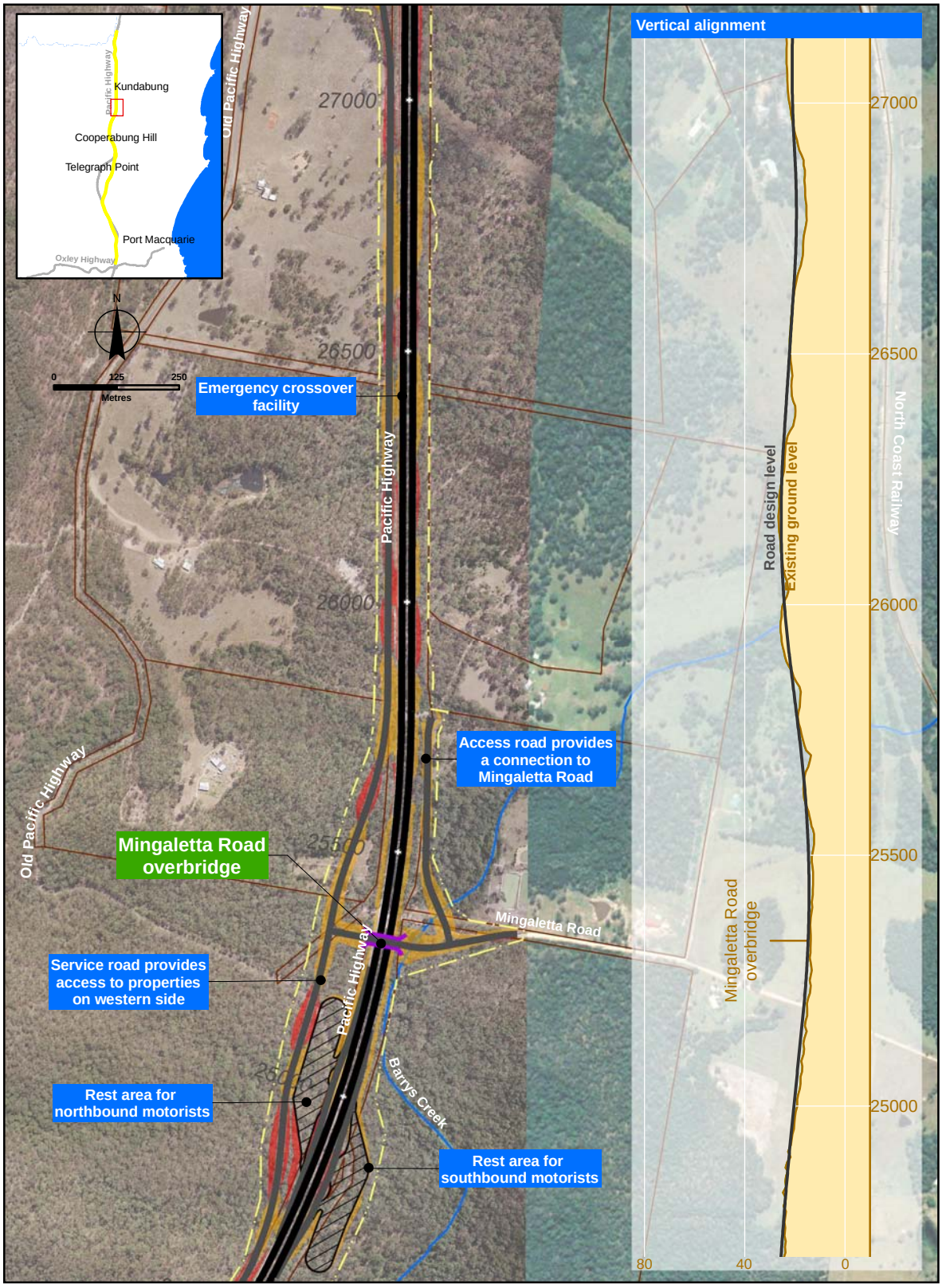
- Road cutting
- Road embankment
- Proposal Boundary

- Cadastre
- Watercourse

+500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

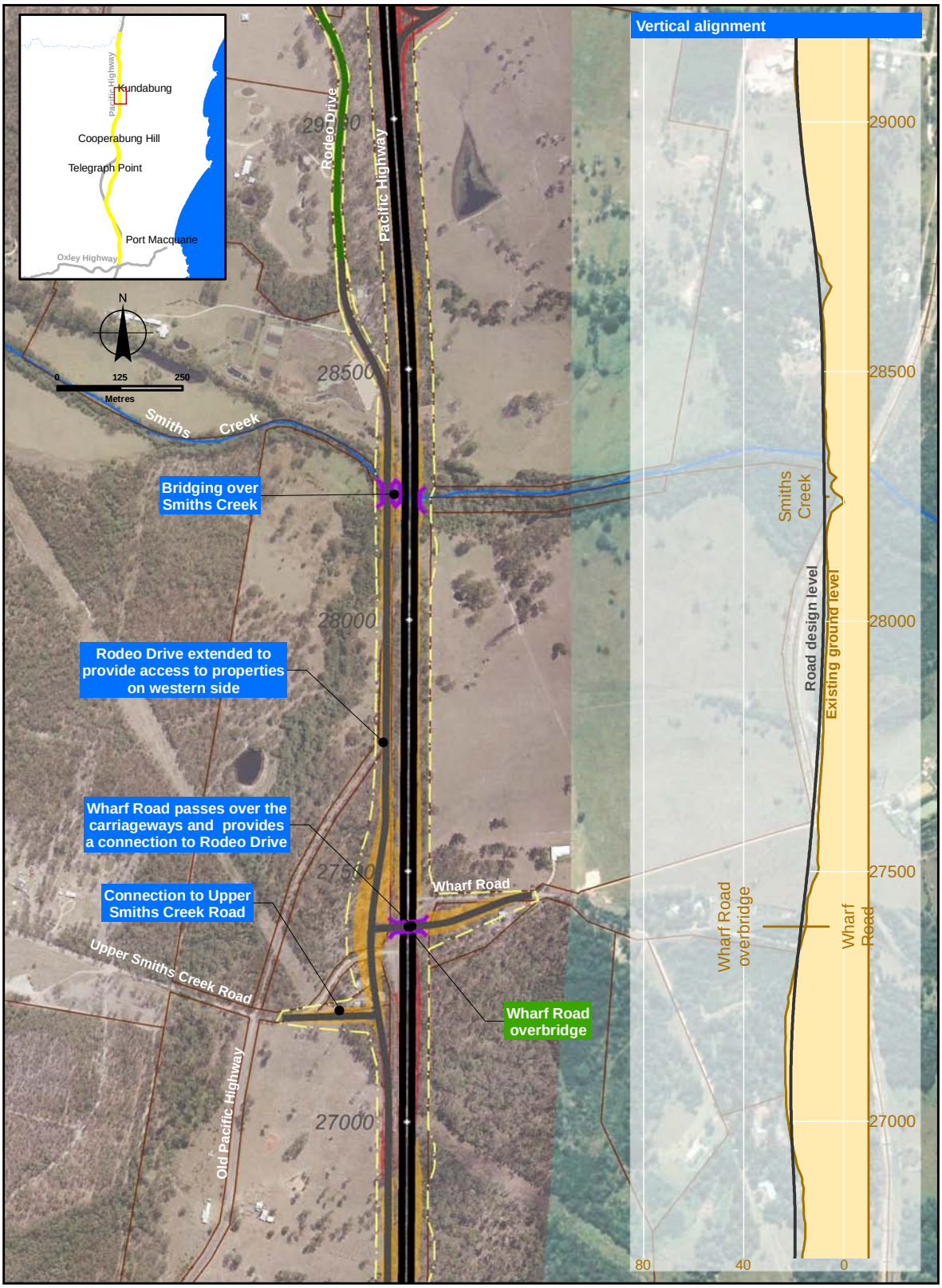
Figure 6-2l The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Rest Area
- Cadastre
- Watercourse
- 500 Station in metres

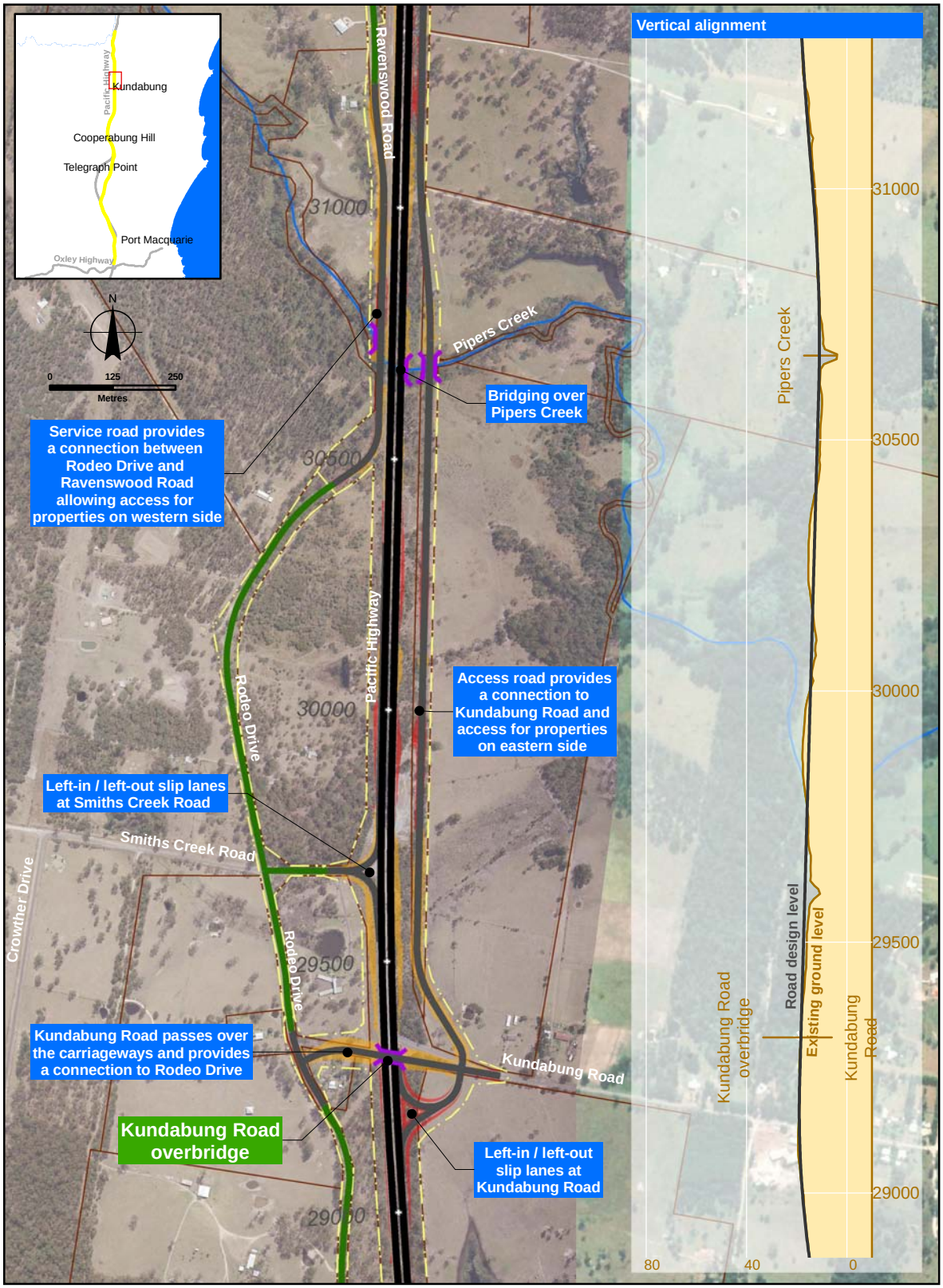
Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-2m The Proposal



Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

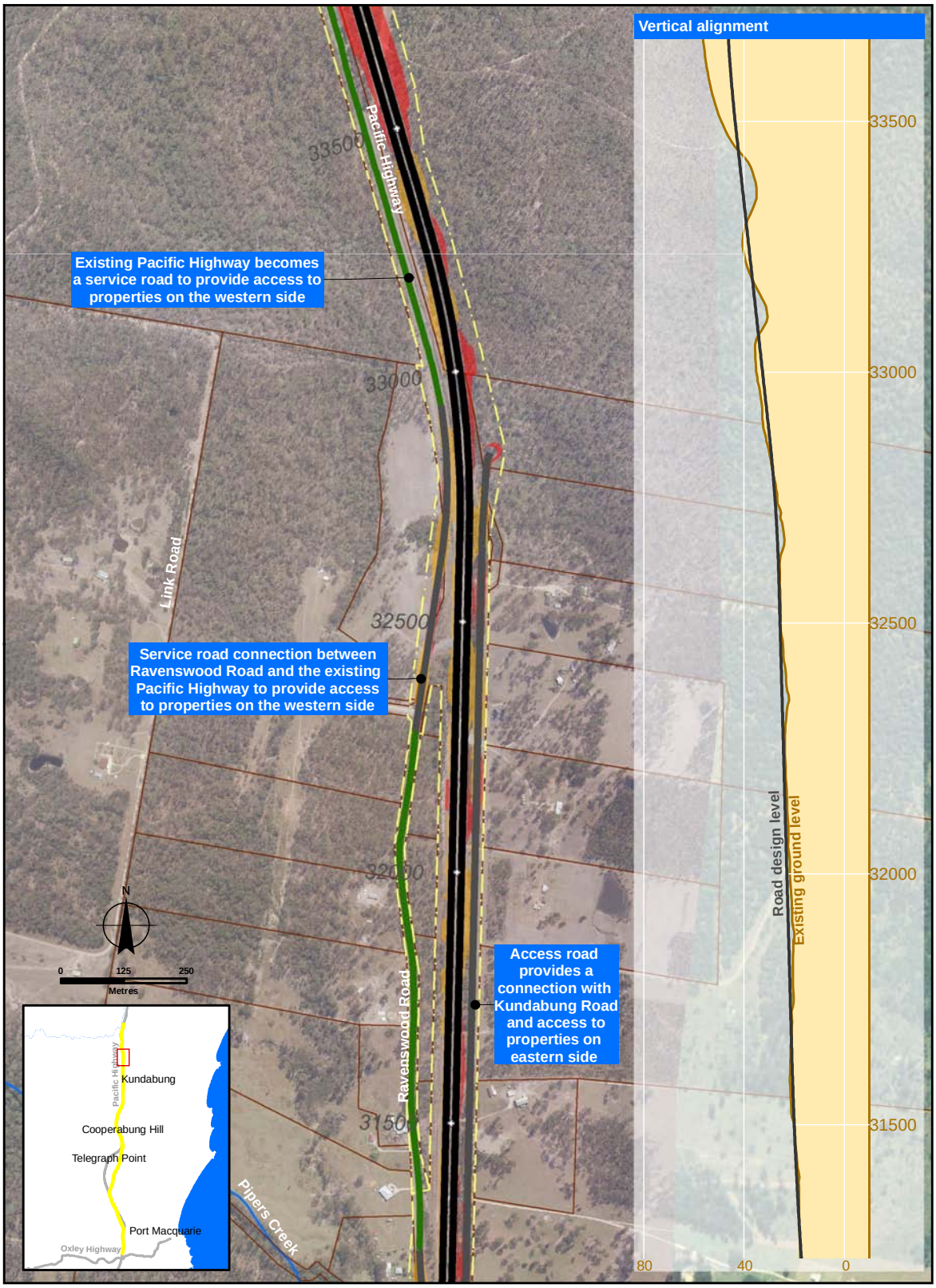
Figure 6-2n The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

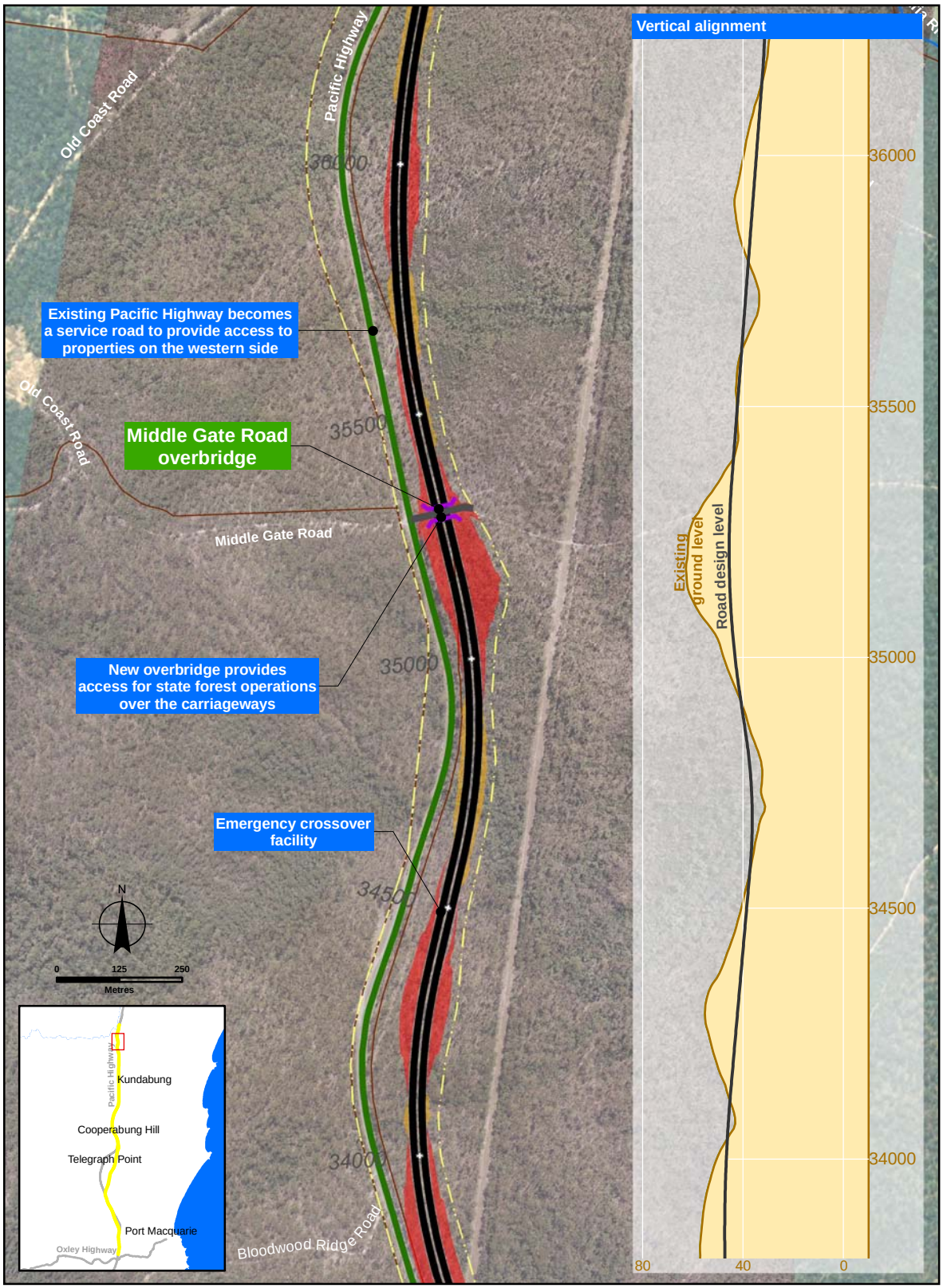
Figure 6-2o The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

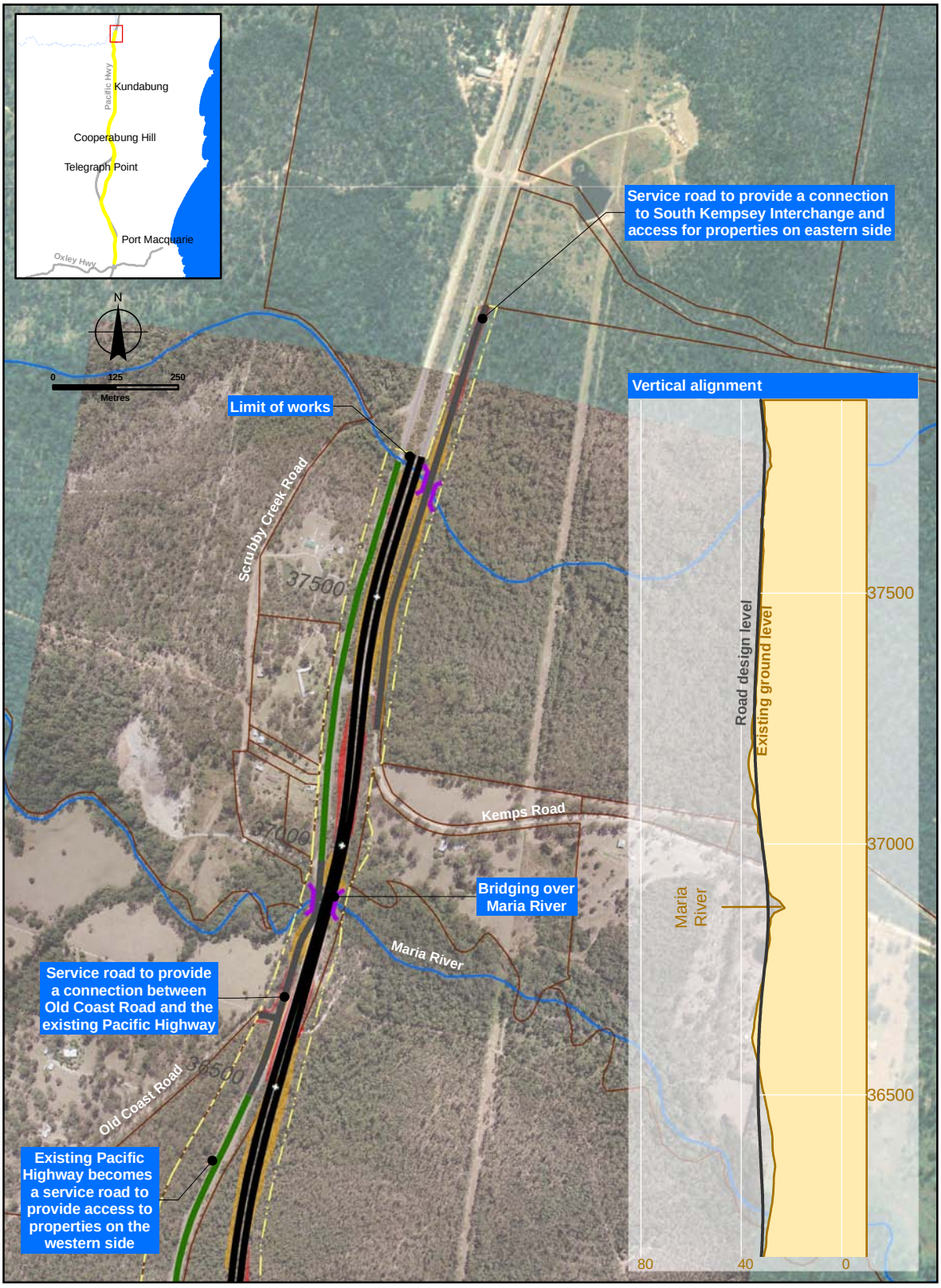
Figure 6-2p The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Railway
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-2q The Proposal



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- Railway
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

6.3.1 Section A

The proposed motorway standard upgraded highway in Section A is shown in **Figure 6-2a** to **Figure 6-2e**.

Commencing approximately 700 metres north of the Oxley Highway interchange, the Proposal would involve duplication on the western side of the existing highway until the right hand curve approximately 900 metres north of the existing Sancrox Road/Fernbank Creek Road intersection. The existing carriageway would be used for southbound traffic.

The service road network in Section A would comprise sections of new road, re-use of sections of existing local roads, and the construction of an overbridge south of Sancrox Road. This traffic arrangement would provide for movements between the upgraded highway, Sancrox Road and Fernbank Creek Road, and for a possible future connection to the Oxley Highway. A new service road would also be constructed to the east of the upgraded highway connecting with the existing highway and providing a link to Hastings River Drive.

At approximately 900 metres north of Sancrox Road the duplication would switch to the eastern side to take advantage of the available road reserve. The upgraded highway would then deviate to the west of the existing highway to cross the Hastings River floodplain and the Hastings River approximately 400 metres upstream of the existing Dennis Bridge. The crossing of the Hastings River (and Glen Ewan Road) would require new bridges for both carriageways and would maintain existing navigational clearances. Flood relief structures would be provided on both southern and northern floodplains of the Hastings River. Two new bridges would be required at Fernbank Creek. A number of major box culverts would require extension through this section.

Construction of the Proposal on the Hastings River floodplain on both sides of the Dennis Bridge would require special techniques to address the existing deep soft soil conditions. Preliminary geotechnical investigations have been carried out to assess the extent of soft soils, as well as confirm soft soil treatment techniques and embankment design. However, further investigations would be required as part of the detailed design phase. The proposed crossing of the Hastings River is located close to and downstream of a bend in the river. Further geomorphological investigations would be required during the detailed design phase to determine bank and riverbed stability.

On the northern bank of the Hastings River, the upgraded highway would continue on a straight alignment and cross the existing highway alignment approximately 1 kilometre south of Blackmans Point Road. At this point the realignment would continue on the eastern side and parallel to the existing highway through to Blackmans Point Road where a full grade separated interchange would be constructed. The interchange would provide connectivity between the upgraded highway and the existing highway to the north and south, Wharf Road and Blackmans Point Road. The interchange would provide for southbound connection to Port Macquarie via Hastings River Drive, and northbound connection to Telegraph Point via the existing highway, which would be retained as a service road.

6.3.2 Section B

The proposed motorway standard upgraded highway in Section B is shown in **Figure 6-2e** to **Figure 6-2i**. Both the motorway and arterial standard (north of Haydons Wharf Road) upgrades are described below.

Motorway standard

North of Blackmans Point Road, the upgraded highway would follow the existing highway alignment on the eastern side for approximately 1.5 kilometres. An overbridge would be constructed to allow Bill Hill Road to cross the upgraded highway. The upgraded highway would then deviate to the east across the Wilson River floodplain and Wilson River east of Telegraph Point. The new carriageways would pass through Cairncross State Forest, and emerge from the state forest and cross the Wilson River floodplain to the east of Moorside Drive. The new carriageways would then continue across the Wilson River and the North Coast Railway, north of the Wilson River. They would re-join the existing alignment in the vicinity of Haydons Wharf Road, where an overbridge and half interchange would be located.

Allowance has been made for the soft underlying soils throughout the Wilson River floodplain. Further assessment of the soft soil conditions (varying depths) in this area would be undertaken as part of the detailed design. Several major flood relief structures would be required across the floodplain, possibly aligned to existing floodplain channels. These relief structures have been designed to minimise the afflux predicted to occur in flood events and would be further refined as part of detailed design.

The alignment would cross the Wilson River at the eastern end of Dalhunty Island approximately 2 kilometres downstream from the existing highway bridge at Telegraph Point. The new bridges over the Wilson River would maintain navigational clearance for vessels passing beneath. The bridge crossing over the Wilson River is likely to require access to Dalhunty Island for bridge construction activities. New bridges would also be required over the North Coast Railway and Cooperabung Creek.

A grade separated half interchange with north facing ramps only would be provided at Haydons Wharf Road, which provides southbound access to Telegraph Point, and northbound access to the upgraded highway from Telegraph Point.

Access to the upgraded highway via the Haydons Wharf Road half interchange would be provided by the service road network, which in this section would comprise the existing highway to the south of the half interchange and Cooperabung Drive to the north. A new service road link would be constructed between the existing highway and Cooperabung Drive using Wyndell Close.

Two new access roads would be constructed to provide for private property access. One would be on the eastern side of the upgraded highway connecting to Haydons Wharf Road, and the second would be on the western side connecting to Cooperabung Drive.

Arterial standard (north of Haydons Wharf Road)

The upgrade of the highway through Section B to the south of Haydons Wharf Road would be the same as proposed for the motorway standard upgrade.

However, for the arterial standard upgrade to the north of Haydons Wharf Road in Section B, no access roads would be provided on either the eastern or western sides of the upgraded highway. As a result, no connection for the eastern access road linking through to Cooperabung Close would be provided in the layout of the half interchange at Haydons Wharf Road.

A left-in / left-out only at-grade intersection would be provided at the intersection of the upgraded highway with Cooperabung Close. Left-in / left-out only access connections would also be provided for a number of private properties in this area, along with U-turn facilities upstream and downstream of the intersection at the Haydons Wharf Road half interchange and the Yarrabee Road traffic arrangement.

Apart from these changes, the Haydons Wharf Road half interchange and the upgraded highway to the north would be the same for the arterial standard upgrade as proposed for the motorway standard upgrade.

6.3.3 Section C

The proposed motorway standard upgraded highway in Section C is shown in **Figure 6-2i** to **Figure 6-2l**. Both the motorway and arterial standard upgrades are described below.

Motorway standard

Through Section C, the Proposal involves duplication of the existing highway alignment. Duplication is proposed on the western side from the north of Haydons Wharf Road to the north of Yarrabee Road. The duplication would then switch to the eastern side where it would continue through to Mingaletta Road.

A major consideration for this section is Cooperabung Hill, which rises from a level of approximately 30 metres Australian height datum to a level of 100 metres Australian height datum. The existing crest through Cooperabung Hill would be lowered approximately 7 metres, resulting in a cutting approximately 31 metres deep. There would also be other major cuttings in this section.

There are several major box culverts that would require extension for the new carriageway from Yarrabee Road to Mingaletta Road. The alignment would have a minor intrusion upon Cooperabung Creek Nature Reserve to the south of Cooperabung Hill and would impact Ballengarra State Forest.

The Old Pacific Highway, (via Yarrabee Road intersection), known as the 'Hill Climb Track' is an accredited Confederation of Australian Motor Sport hill climb track. Part of the hill climb entry area adjoining Yarrabee Road would be directly affected by the road works for the Yarrabee Road vehicular underpass, but this should not prevent the continued operation of this facility. However, further to the north a section of the old road used for the hill climb track is located within the existing road reserve boundary. While this section of the old road would be close to the Proposal, the legal use of this section of the Hill Climb Track is an existing problem that is not related to the Proposal and therefore lies outside the scope of this assessment.

At Yarrabee Road, access to the upgraded highway would be provided for by a traffic arrangement, comprising a vehicular underpass and left-in / left-out provision for southbound movements at the existing intersection, and for northbound movements approximately 550 metres further to the north.

A new service road would be constructed to the west of the upgraded highway throughout the entire length of this section. A new overbridge would be provided to connect Mingaletta Road to the new service road on the western side of the Proposal.

Two new rest areas for southbound and northbound traffic would be constructed just south of Mingaletta Road.

Arterial standard

Upgrade to an arterial standard through Section C would be the same as proposed for the motorway standard upgrade except for the provision of a service road on the western side of the upgraded highway and service road connection to Mingaletta Road (overbridge).

No service road would be provided on the western side of the upgraded highway throughout this section other than a service road connection at the southern end from Cooperabung Drive to the Cooperabung Creek Nature Reserve. A left-in turn only from the upgraded highway to Cooperabung Drive would be provided at the foot of Cooperabung Hill. Access to the upgraded highway for residents in this area would be via Cooperabung Drive and Wyndell Close and the Haydons Wharf Road half interchange to the south.

At Mingaletta Road no overbridge connection would be provided as proposed in the motorway standard. An at-grade intersection with left-in / left-out only would be provided at this location along with U-turn facilities upstream and downstream of the intersection.

The traffic arrangement at Yarrabee Road would be the same as proposed for the motorway upgrade.

6.3.4 Section D

The proposed motorway standard upgraded highway in Section D is shown in **Figure 6-2l** to **Figure 6-2q**. Both the motorway and the arterial standard upgrades are described below.

Motorway standard

The duplication of the existing highway alignment would continue on the eastern side through this Section D, along the Kundabung straight to the northern end of Ravenswood Road. Construction of the additional carriageway on the eastern side would take advantage of the available road reserve and minimise property acquisition.

Between the end of the Kundabung straight and the Maria River, realignment on the eastern side of the existing highway is required to achieve a 110 kilometres per hour design speed. At the Maria River, the realignment would connect to the southern end of the existing section of dual carriageway. A new northbound carriageway is proposed between the existing carriageways through to Stumpy Creek.

New bridges would be required for Smiths Creek and Pipers Creek, as well as a new southbound bridge at Stumpy Creek. At Maria River, a new dual carriageway bridge crossing was recently constructed, and no additional bridge works would be required as part of the Proposal.

Existing major box culverts would be extended where necessary through this section. A new overbridge would be provided to connect Wharf Road with the western service road. An overbridge and traffic arrangement would be provided to connect Kundabung Road with the western service road and the upgraded highway. A new overbridge would also be constructed near Middle Gate Road to provide access to and from the Maria River State Forest.

The service road network through this section would comprise sections of new road linking the existing sections of Rodeo Drive, Ravenswood Road and the existing highway through Maria River State Forest, to the west of the upgraded highway. Two new access roads would be constructed to the east of the upgraded highway to provide for private property access to Mingaletta Road and Kundabung Road. North of the Maria River a new access road would be constructed to link Kemps Road to the proposed Kempsey to Eungai interchange.

The existing timber bridge would be retained as part of the western service road subject to re-evaluation of its condition during the detailed design phase.

The existing rest area facility opposite Smiths Creek Road and south of Maria River would be replaced by two new rest areas south of Mingaletta Road.

Arterial standard

Upgrade to an arterial standard through Section D would be same as proposed for the motorway standard upgrade except for the provision of some service roads and access roads on the eastern and western sides of the upgraded highway and the service road connection to Wharf Road (overbridge).

No service road would be provided on the western side of the upgraded highway throughout this section other than a service road connection between Rodeo Drive and Ravenswood Road and Ravenswood Road and the existing highway further to the north.

At Wharf Road, no overbridge connection would be provided as proposed in the motorway standard. An at-grade intersection with left-in / left-out only would be provided at the intersection with Upper Smiths Creek Road and Wharf Road along with U-turn facilities upstream and downstream of the intersections. A similar treatment would be provided at Mobbs Drive on the eastside.

For properties on the eastern side of the upgraded highway in the vicinity of Pipers Creek the access road would not be extended to the south to link with Kundabung Road as proposed in the motorway upgrade. An at-grade intersection with left-in / left-out and right-turn in would be provided along Kundabung Straight for the properties on the eastern side.

In the area of Maria River, the intersections on the eastside at Old Camp Road and Kemps Road would be at-grade intersections with left-in / left-out provision only. A U-turn facility would be provided to the south of the Maria River for northbound access to Kempsey. U-turn facilities exist in the existing section of dual carriageway to the north.

The traffic arrangement at Kundabung Road would be the same as proposed for the motorway upgrade. Access to the upgraded highway for residents in the Kundabung area would be via this traffic arrangement.

6.4 Design elements

The Proposal is based on a concept design, which has been prepared using the best available information and the current design standards for the Pacific Highway Upgrade Program. The details and dimensions of the design elements described below are indicative only and would be subject to further refinement as a result of the outcomes of the approval process and the availability of additional information during later phases.

6.4.1 Proposal boundary and property acquisition

The Proposal boundary width would vary across the length of the Proposal. Where possible the Proposal has sought to maximise the use of the existing highway road reserve.

The upgraded highway's dual carriageways and the service road network would be accommodated within the Proposal boundary, together with road embankments/cuttings, landscaping, sedimentation basins and other water quality control measures, fencing and other environmental management measures.

For the majority of the alignment, where the road is at or near ground level, the Proposal boundary width would generally be approximately 100 metres to minimise the extent of property acquisition and other environmental impacts. In some sections the width of the Proposal boundary would increase to cater for interchanges, traffic arrangements, deep cuttings, embankments, rest areas and traffic arrangements. Examples include the Blackmans Point Road interchange where the width is about 320 metres, the cutting at Cooperabung Hill where the width is about 175 metres, and the rest areas where the width is about 230 metres.

The Proposal would require acquisition of land from both public and private property owners. The majority of these properties would be subject to partial acquisition, but some properties would require total acquisition due to the level of impact on them. Property acquisition requirements for the Proposal are identified in **Chapter 10 Land use and property**.

The Proposal boundary is shown in **Figure 6-2a** to **Figure 6-2q**. The Proposal boundary has been established generally in accordance with the following:

- 15 metres from the top of cuttings.
- 15 metres from the toe of fill embankment batters.
- 6 metres from edge of permanent sedimentation basins.
- 6 metres from edge of cut and fill batters for service and access roads.

It should be noted that the Proposal boundary is wider than the Proposal footprint, and not all areas within the Proposal boundary would require clearing for construction.

The concept design and Proposal boundary have incorporated a number of minor adjustments in order to minimise property impacts and to respond to particular constraints and opportunities. Minor adjustments to the Proposal boundary may be required as a result of design refinements undertaken during the detailed design and investigation phase.

6.4.2 Proposed deviations from the existing highway

The Proposal would be a combination of duplication of the existing highway and sections of realignment. The main realigned sections or deviations of the upgraded highway would be:

- Hastings River deviation (**Figure 6-2c** to **Figure 6-2e**).
- Telegraph Point bypass (**Figure 6-2e** to **Figure 6-2i**).
- Maria River State Forest deviation (**Figure 6-2o** to **Figure 6-2q**).

The sections of the existing highway left as a result of these deviations would be retained for use as part of the proposed service road network. Following hand over negotiations with Port Macquarie-Hastings Council and Kempsey Council, it is proposed to hand over control of these assets, along with the newly constructed service and access roads, to the relevant council following completion of construction of the Proposal.

Hastings River deviation

As detailed in **Section 6.3.1**, the Proposal's alignment would involve a deviation on the western side of the existing Pacific Highway alignment from just south of Fernbank Creek to the proposed interchange at Blackmans Point Road. This deviation would include the construction of:

- A raised embankment across the Hastings River floodplain for the two proposed carriageways. This embankment would contain flood relief structures.

- New twin bridges across Fernbank Creek.
- New twin bridges across the Hastings River.
- A grade separated interchange at Blackmans Point Road.

Telegraph Point bypass

As detailed in **Section 6.3.2**, the Telegraph Point bypass would commence just north of Blackmans Point Road and run parallel to the existing highway on the eastern side to just south of Bill Hill Road where it would deviate to the east. The Proposal would then bypass Telegraph Point to the east and re-join the existing highway at the proposed Haydons Wharf Road half interchange. This deviation would include the construction of:

- A new vehicular underpass north of Blackmans Point Road for the existing highway and service road network.
- A raised floodplain embankment across the Wilson River floodplain for the two proposed carriageways. This embankment would contain flood relief structures.
- A new overbridge at Bill Hill Road to retain connection between Bill Hill Road and the existing highway.
- New twin bridges across the Wilson River.
- New twin bridges over the North Coast Railway.
- A grade separated half interchange and associated overbridge at Haydons Wharf Road.

Maria River State Forest deviation

As detailed in **Section 6.3.4**, the Maria River State Forest deviation would commence at the end of the Kundabung straight and deviate to the east through the Maria State Forest, rejoining the existing highway alignment at Maria River.

6.4.3 Interchanges

Two grade separated interchanges would be constructed as part of the Proposal. These would be:

- A full interchange in the vicinity of Blackmans Point Road.
- A north facing half interchange at Haydons Wharf Road.

Blackmans Point Road interchange

The proposed interchange in the vicinity of Blackmans Point Road would be a full interchange. This interchange would provide access between the upgraded highway and Telegraph Point to the north and Port Macquarie to the south via Hastings River Drive. The proposed interchange would be located to the south of the existing intersection of the existing Highway and Blackmans Point Road and would include:

- Northbound and southbound on- and off-ramps.
- An overbridge.
- A roundabout on the eastern side of the overbridge.
- A service road connection on the eastern side of the upgraded highway to provide a southern connection to the existing Pacific Highway, providing access to Hastings River Drive via the Dennis Bridge.

- A vehicular underpass to the north of Blackmans Point Road to connect the eastern service road with the western service roads and the existing Pacific Highway to allow northbound access to Telegraph Point.

This interchange would provide access to, and local movements between, Port Macquarie, Telegraph Point and Blackmans Point and surrounding areas using the new service roads and existing local roads connected to the proposed interchange. This would provide for a separation of local and highway traffic. The layout of the proposed Blackmans Point Road interchange is shown in **Figure 6-3**.

Haydons Wharf Road half interchange

The proposed Haydons Wharf Road half interchange would comprise:

- Northbound on-ramp.
- Southbound off-ramp.
- An overbridge at Haydons Wharf Road.
- An extension of Wyndell Close between the existing Pacific Highway and Cooperabung Drive on the western side of the alignment to provide a connection between Haydons Wharf Road and the local road network.

The layout of the proposed Haydons Wharf Road half interchange is shown in **Figure 6-4**.

A short length of the existing Pacific Highway north of the intersection with Haydons Wharf Road would be retained as the northbound on-ramp for the half interchange. The existing Pacific Highway south of Haydons Wharf Road would be retained as a service road.

This half interchange would provide southbound highway traffic access to Telegraph Point and the surrounding area through the local service road network. It would also provide local northbound traffic access to the Proposal.

Access between Telegraph Point and Port Macquarie would be maintained for local traffic utilising the network created by linking the existing highway with proposed new service and access roads.

6.4.4 Traffic arrangements

Traffic arrangements are modified grade separations where the on- and off-ramps are separated from the overbridge or vehicular underpass structure. These would be located at:

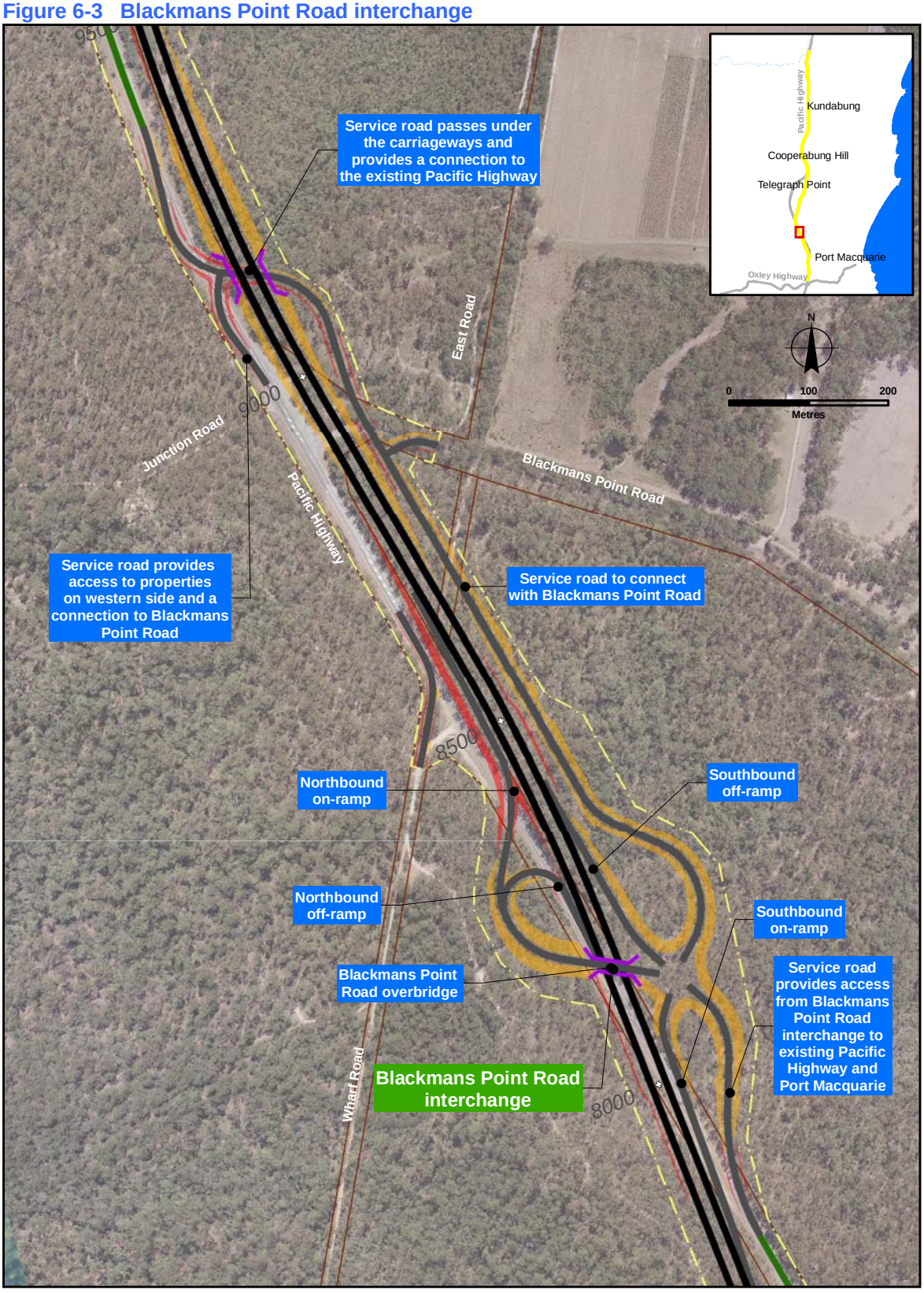
- Sancrox Road / Fernbank Creek Road.
- Yarrabee Road.
- Kundabung Road / Rodeo Drive / Smiths Creek Road.

Sancrox Road / Fernbank Creek Road

The proposed layout of the Sancrox Road and Fernbank Creek traffic arrangement and associated service roads are shown in **Figure 6-5** and would include:

- An overbridge approximately 600 metres south of Sancrox Road.
- Service roads to link Sancrox Road and Fernbank Creek Road to the proposed overbridge.
- New roundabouts where the new service roads meet Sancrox Road and Fernbank Creek Road.

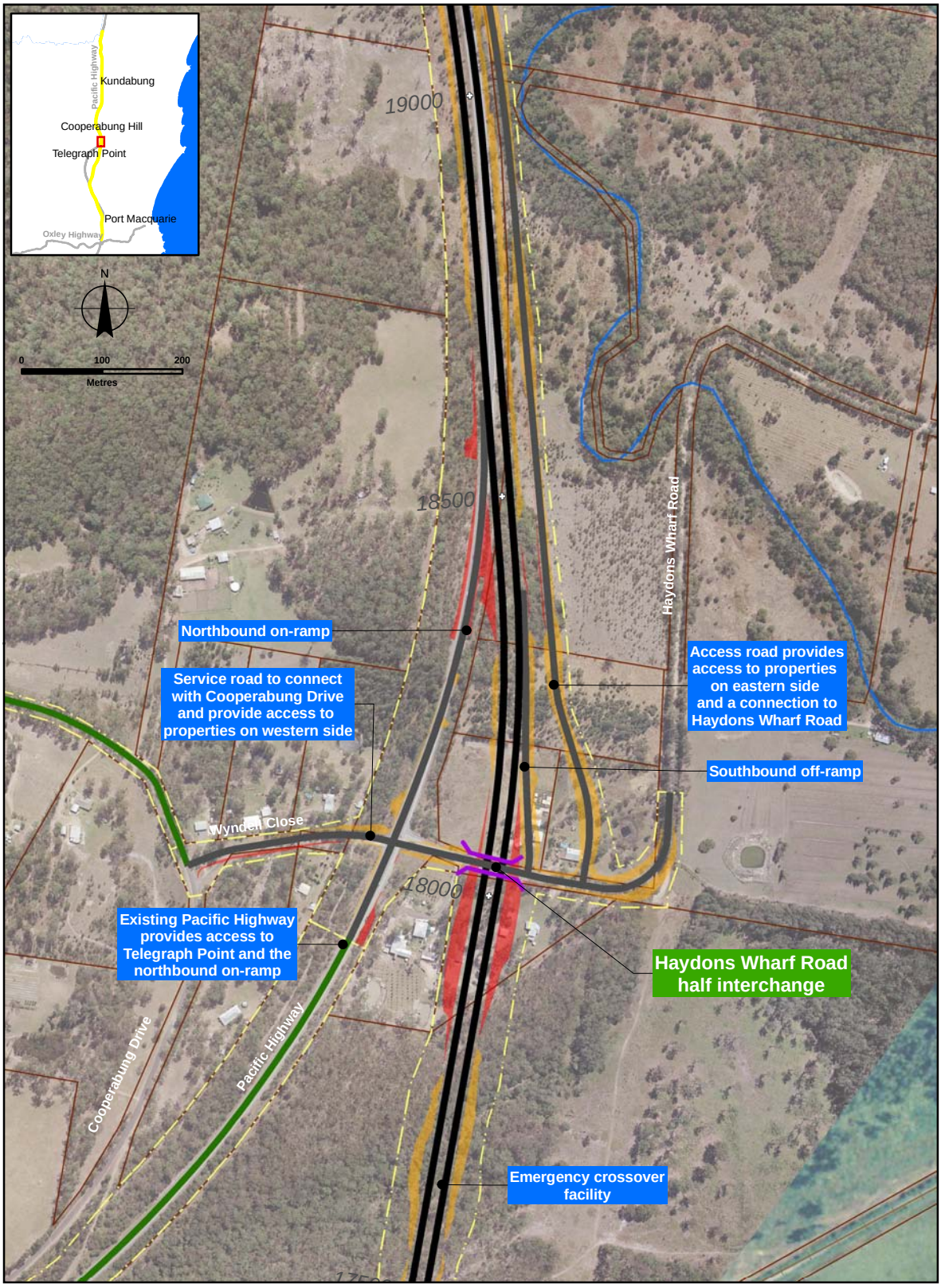
Figure 6-3 Blackmans Point Road interchange



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- 500 Station in metres

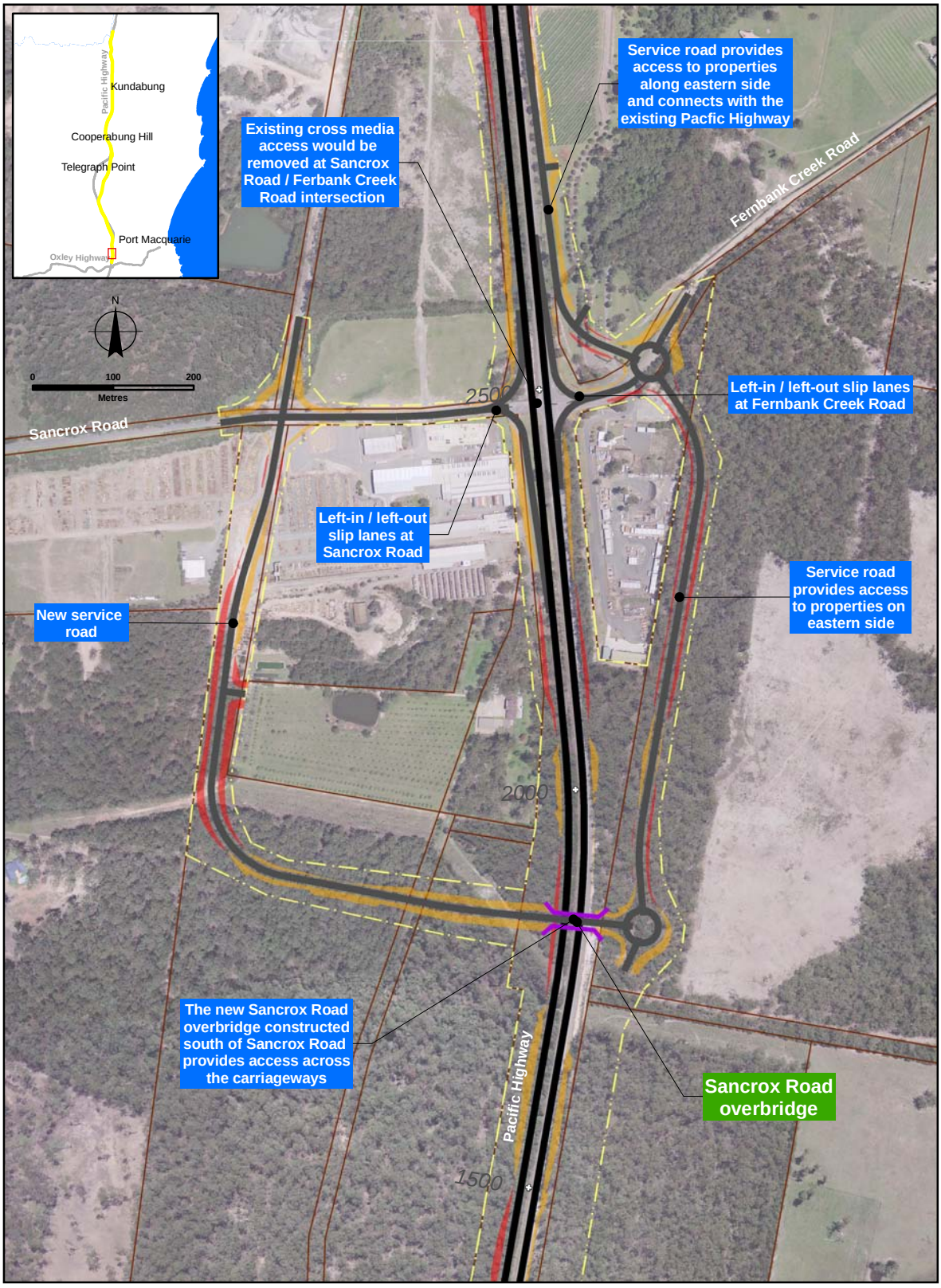
Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-4 Haydons Wharf Road half interchange



Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Figure 6-5 Sancrox Road and Fernbank Creek Road traffic arrangement



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

- A new roundabout on the eastern side of the overbridge for future service road connection.
- A new service road on the eastern side of the upgraded highway to connect Fernbank Creek Road with the existing highway to the north at Fernbank Creek.
- Access to and from the upgraded highway via left-in / left-out slip lanes at Sancrox Road and Fernbank Creek Road.

A new service road system would provide cross-highway traffic movements between Sancrox Road and Fernbank Creek Road via the proposed overbridge south of Sancrox Road, separating highway and local traffic.

Northbound access to and from Sancrox Road would be available via the entry and exit slip lanes. Southbound access to Sancrox Road would be available by exiting the upgraded highway using the southbound exit slip lane at Fernbank Creek Road and the new service road and overbridge.

Northbound access to Fernbank Creek Road would be available by exiting the upgraded highway using the northbound exit slip lane at Sancrox Road and the proposed overbridge. Southbound access to and from Fernbank Creek Road would be available via the entry and exit slip lanes.

Yarrabee Road

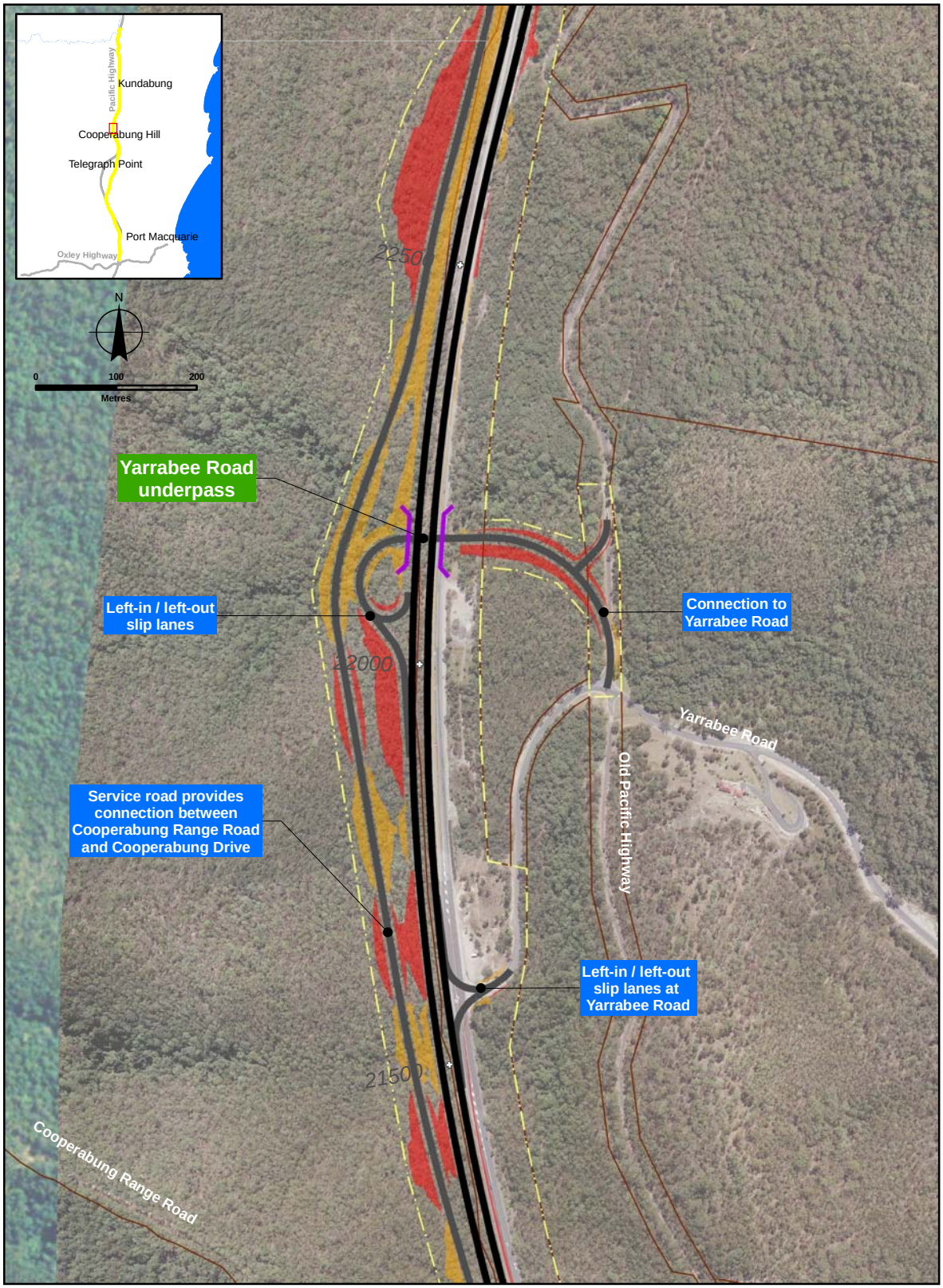
The layout of the proposed traffic arrangement and associated service road network at Yarrabee Road is shown in **Figure 6-6** and would include:

- Construction of a new service road that passes beneath the upgraded highway approximately 600 metres north of the intersection of the existing Pacific Highway and Yarrabee Road.
- An access road connection on the eastern side from the new service road to the Old Pacific Highway.
- Northbound access to Yarrabee Road via left-in / left-out slip lanes proposed as part of the vehicular underpass arrangement.
- Southbound access to and from the upgraded highway via left-in / left-out slip lanes at Yarrabee Road.
- An additional slow vehicle lane on the southbound carriageway south of Yarrabee Road to Cooperabung Hill.

Northbound access to and from Yarrabee Road would be available via the entry and exit slip lanes on the western side of the Proposal, vehicular underpass and the new service road. Southbound access to and from Yarrabee Road would be available via entry and exit slip lanes. The new service road system and proposed vehicular underpass would allow safe access to and from the upgraded highway for local traffic, particularly heavy vehicles entering and exiting the existing quarry located on the eastern side of the upgraded highway. There would be no access between the service road on the western side of the upgraded highway and the Yarrabee Road traffic arrangement.

The additional climbing lane for the southbound carriageway on the exit from Yarrabee Road would provide heavy vehicles from the quarry with an additional acceleration lane to reach highway speed when climbing the steep grade south through Cooperabung Hill.

Figure 6-6 Yarrabee Road traffic arrangement



Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Kundabung Road / Rodeo Drive / Smiths Creek Road

The layout of the proposed traffic arrangement and associated service road network in the vicinity of Kundabung Road, Rodeo Drive and Smiths Creek Road is shown in **Figure 6-7** and would include:

- An overbridge across the upgraded highway immediately south of the existing Kundabung Road.
- New service roads to provide a link between Kundabung Road, Rodeo Drive and Smiths Creek Road via the proposed overbridge.
- Southbound access to and from the upgraded highway via left-in / left-out slip lanes south of the overbridge and existing Kundabung Road intersection.
- Northbound access to and from the upgraded highway via left-in / left-out slip lanes at Smiths Creek Road north of the overbridge and existing Kundabung Road intersection.
- A new access road on the eastern side of the Proposal to provide access to properties north of Kundabung Road.

A new service road system would provide safe cross-highway traffic movements between the eastern and western parts of Kundabung via the proposed overbridge south of Kundabung Road, separating highway and local traffic. Northbound access to and from Smiths Creek Road would be available via entry and exit slip lanes. Southbound access to and from Kundabung Road would be available via entry and exit slip lanes.

The new service road system and proposed overbridge would also allow access to and from the upgraded highway from both sides of Kundabung. The access road north of Kundabung Road on the eastern side would consolidate existing property accesses and control direct access to the Proposal.

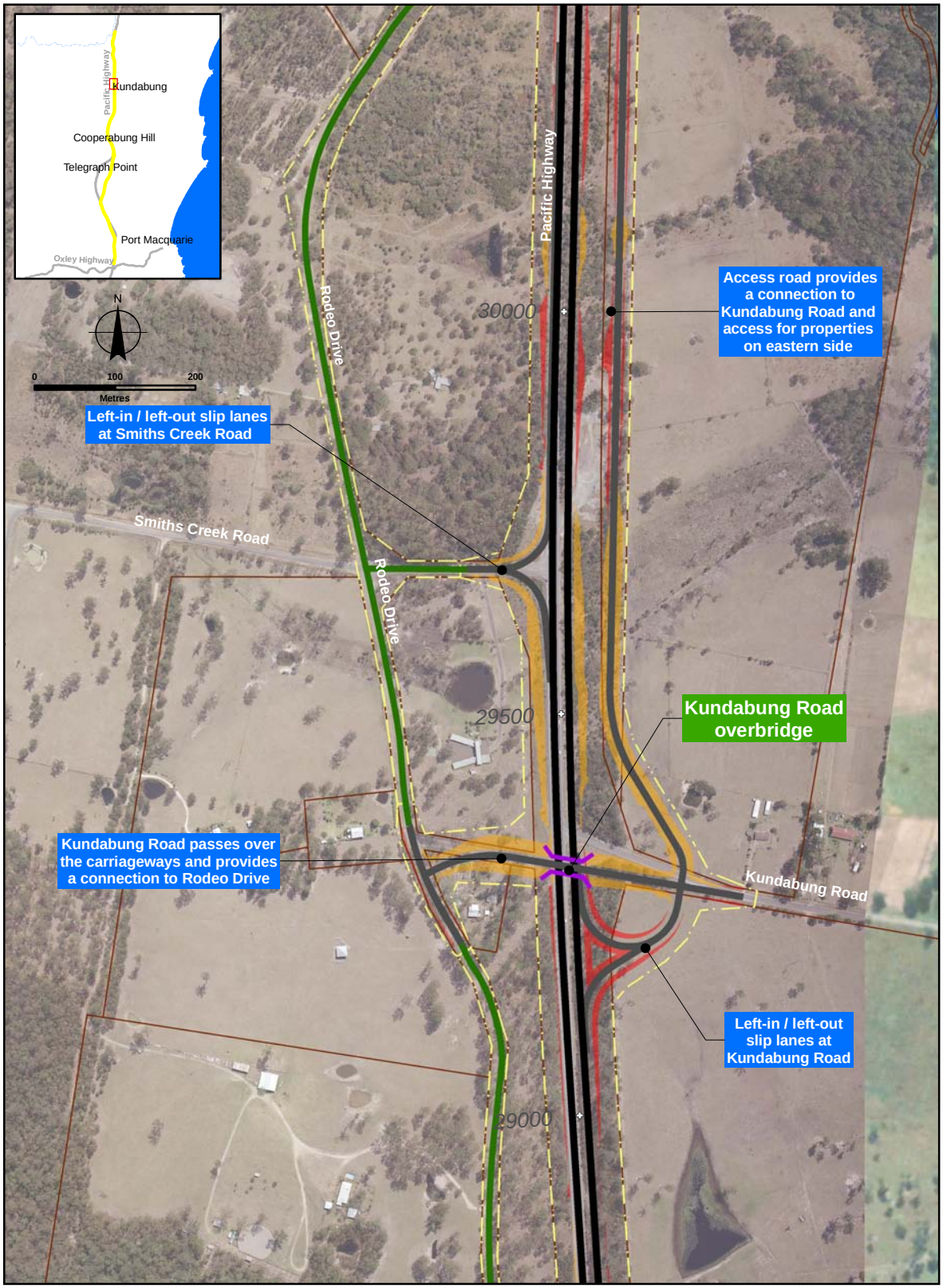
6.4.5 Service and access roads

As a key element of the Proposal, new service and access roads would be constructed to connect with the existing local road network and private properties. Some of the existing local roads that would form part of the service road network may require upgrading, the extent of which would be determined during detailed design.

The sections of the existing Pacific Highway left as a result of these deviations would be retained for use as part of the service road network. Following hand over negotiations with Port Macquarie-Hastings Council and Kempsey Council, it is proposed to hand over control of these assets, along with the newly constructed service roads, to the relevant council following completion of construction of the Proposal.

The proposed service road network is shown in **Figure 6-1a** to **Figure 6-1b** and **Figure 6-2a** to **Figure 6-2q** and described in detail in this section.

Figure 6-7 Kundabung Road and Rodeo Drive traffic arrangement



The Proposal
- Two-lane road carriageway
- Service / Access Road (new facility)
- Service / Access Road (existing facility)
- Bridge
- Road cutting
- Road embankment
- Proposal Boundary
- Cadastre
- Watercourse
- 500 Station in metres

Note: 2004 Aerial photography, Cadastral boundaries are indicative only. All design features are subject to refinement during detailed design.

Design criteria

In accordance with the *Pacific Highway Design Guidelines* (RTA 2005a), the *Road Design Guide* (RTA 1988) and *Austroads' Guide to Traffic Engineering Practice* (Austroads 1998), the service and access road design is based upon the design criteria set out in **Table 6-4**.

Table 6-4 Service road and access road design criteria

Design element	Service road design criteria	Access road design criteria
Signposted speed	80 km/h	50 km/h
Horizontal alignment	80 km/h	60 km/h
Vertical alignment	80 km/h	60 km/h
Stopping sight distance (reaction time)	100 m (1.5 seconds)	45 m (1.5 seconds)
Lane width	3.5 m	3.0 m
Flood immunity	20 year average recurrence interval event	10 year average recurrence interval event (desirable)

Sight distance

Sight distance requirements on the service roads and access roads would be met in accordance with the design guidelines, in particular:

- Stopping sight distance at all locations.
- Approach sight distance on the approaches to all at-grade intersections.
- Headlight sight distance.

Cross section

Service roads would generally comprise two 3.5 metre wide travel lanes with 2 metre wide sealed shoulders. Access roads would generally comprise two 3 metre wide sealed travel lanes with 0.5 metre wide unsealed shoulders.

Description of service and access roads

An outline of the service and access road features of the Proposal is provided below. As discussed in **Section 6.1**, the Proposal could be constructed in stages. The following provides a description of the service and access road network for the motorway standard. A detailed description of the arterial standard for Sections C and D is provided in **Section 6.3**. Further information on staging options is provided in **Section 7.3**.

Section A

- A new service road (approximately 2.5 kilometres long) would connect Sancrox Road on the western side of the upgraded highway with Fernbank Creek Road on the eastern side of the upgraded highway via a new overbridge over the upgraded highway approximately 700 metres south of the existing Sancrox Road / Pacific Highway intersection. Roundabouts are proposed at the service road intersections with Sancrox Road and Fernbank Creek Road as part of this traffic arrangement.
- As part of the new service road above, only left-in / left-out movements would be provided where Sancrox Road and Fernbank Creek Road join the upgraded highway.

- A new service road (approximately 2.1 kilometres long) would be constructed on the eastern side and parallel with the upgraded highway between Fernbank Creek Road and the existing Pacific Highway at Fernbank Creek. This would provide a connection between Fernbank Creek Road and Hastings River Drive.
- The existing highway would be utilised as a service road between Fernbank Creek and the Blackmans Point Road interchange.
- A new access road would be provided between Wharf Road on the western side of the upgraded highway and the existing highway service road opposite Blackmans Point Road.
- Blackmans Point Road would be linked to the interchange via a new service road (approximately 800 metres long) on the western side.

Section B

- A service road vehicular underpass (beneath the upgraded highway) is proposed approximately 300 metres north of Blackmans Point Road. This would provide connection between the Blackmans Point Road interchange, Wharf Road and the existing highway (to be used as a service road) to the north.
- The existing Pacific Highway would be retained as a service road between the vehicular underpass near Blackmans Point Road and the Haydons Wharf Road half interchange.
- An overbridge is proposed at Bill Hill Road, retaining the connection to the existing Pacific Highway. Approximately 500 metres of Bill Hill Road would require reconstruction.
- At the Haydons Wharf Road half interchange, north-facing ramps would be constructed providing for northbound access to the Proposal and southbound exit from the upgraded highway.
- A new connection (approximately 250 metres long) would be constructed to link Cooperabung Drive with the existing highway, and the Haydons Wharf Road half interchange.
- A new access road (approximately 1800 metres long) would be constructed on the eastern side of the upgraded highway linking Haydons Wharf Road with residential properties to the north of Cooperabung Creek.
- A new access road (approximately 800 metres long) would be constructed on the western side of the upgraded highway linking Cooperabung Drive with the existing property south of Cooperabung Creek.

Section C

- A new service road is proposed on the western side of the upgraded highway for the full length of this section. This service road would link Cooperabung Drive with the proposed traffic arrangement at Mingaletta Road. Due to the topography in this area, the service road would be incorporated into the proposed cuttings for the upgraded highway.
- Left-in / left-out slip lanes are proposed on both the northbound and southbound carriageways near the existing Yarrabee Road intersection as part of the traffic arrangement. A vehicular underpass would link the northbound slip lane to Yarrabee Road.
- An access road is proposed to link Yarrabee Road with the Old Pacific Highway.

Section D

- An overbridge is proposed at Mingaletta Road, providing connection between the service road on the west side of the upgraded highway and Mingaletta Road. Approximately 250 metres of Mingaletta Road would require realignment on the eastern side of the upgraded highway.
- A new access road (approximately 500 metres long) is proposed to provide access to an existing private property to the north of Mingaletta Road.
- A new service road (approximately 3.2 kilometres long) is proposed on the western side of the upgraded highway between Mingaletta Road and Rodeo Drive. The service road would also intersect with Upper Smiths Creek Road to the west and Wharf Road to the east. A new bridge would be required at Smiths Creek.
- A new overbridge is proposed at Wharf Road, which would connect with the proposed service road on the western side of the upgraded highway. Approximately 300 metres of Wharf Road would require realignment.
- Approximately 200 metres of Upper Smiths Creek Road would be realigned near the intersection with the proposed service road to provide adequate separation between Upper Smiths Creek Road intersection and the Wharf Road intersection.
- A new service road (approximately 400 metres long) and an overbridge are proposed at Kundabung Road, providing connection between Rodeo Drive on the west side of the upgraded highway and Kundabung Road on the eastern side of the upgraded highway. Approximately 250 metres of Kundabung Road would require realignment.
- A new left-in / left-out only traffic arrangement is proposed to the south of Kundabung Road overbridge to provide for southbound entry and exit vehicle movements to Kundabung Road, Rodeo Drive and Smiths Creek Road.
- A left-in / left-out only traffic arrangement is proposed at the existing Smiths Creek Road intersection, north of the Kundabung Road overbridge to provide for northbound entry and exit vehicle movements to Smiths Creek Road, Rodeo Drive and Kundabung Road.
- A new access road (approximately 3.5 kilometres long) is proposed on the eastern side of the upgraded highway providing access for properties to the north of Kundabung Road. A new bridge would be required at Pipers Creek.
- A new service road connection (approximately 800 metres long) between Rodeo Drive and Ravenswood Road is proposed on the western side of the upgraded highway. This service road would require a new bridge at Pipers Creek.
- A new connection, approximately 700 metres long, would be constructed linking the northern end of Ravenswood Road with the existing highway. The existing highway would be utilised as a service road between Ravenswood Road and Old Coast Road.
- Opposite Middle Gate Road an access road connection is provided for access to and from the Maria River State Forest. An overbridge would be constructed over the upgraded highway as part of this connection from the existing highway to the Maria River State Forest.
- A new service road is proposed on the western side of the upgraded highway, linking the existing highway either side of Maria River. A new intersection between Old Coast Road and the proposed service road would be required.

- The existing timber bridge at Maria River is proposed to be retained as part of the western service road. The alignment of the service road in this location is sub-standard for 80 kilometres per hour and condition assessment would be required during detailed design to confirm the bridge's suitability and load carrying capacity.
- North of Maria River, the existing northbound carriageway is to be utilised as a service road linking to the southern interchange of the proposed Kempsey to Eungai Pacific Highway upgrade.
- A new access road is proposed on the eastern side of the upgraded highway, linking the southern interchange of the proposed Kempsey to Eungai upgrade with Kemps Road.

6.4.6 Bridges

A number of new bridges would be required for the Proposal. These include:

- Bridges across the Hastings River and Wilson River.
- Bridges at the proposed interchanges and traffic arrangements.
- Bridges over the North Coast Railway.
- Other bridges for overbridges, vehicular underpasses and watercourse crossings.

Bridges over the Hasting and Wilson rivers could accommodate three lanes if required in the future. All other bridges for the dual carriageway would require widening to accommodate future widening to three lanes.

Bridge safety screens would be provided on all bridges crossing the upgraded highway in accordance with RTA Policy TD-2002-RS02.

Key features of these bridges are discussed briefly in the following sections and typical cross sections for bridges are provided in **Figure 6-8**. The type and method of construction of these bridges is subject to refinement in the detailed design phase and the following sections discuss indicative general arrangements only.

Major river crossings

Hastings River bridges

The Hastings River bridges would be parallel structures approximately 570 metres long, crossing Glen Ewan Road, the Hastings River and the associated floodplain. The twin bridges would extend from the southern side of Glen Ewan Road on the south side of the river to the raised land on the northern side of the river. Typical features of the proposed Hastings River bridges are summarised in **Table 6-5**. The Dennis Bridge on the existing Pacific Highway would remain in use for the local service road.

Figure 6-8 Typical bridge cross section

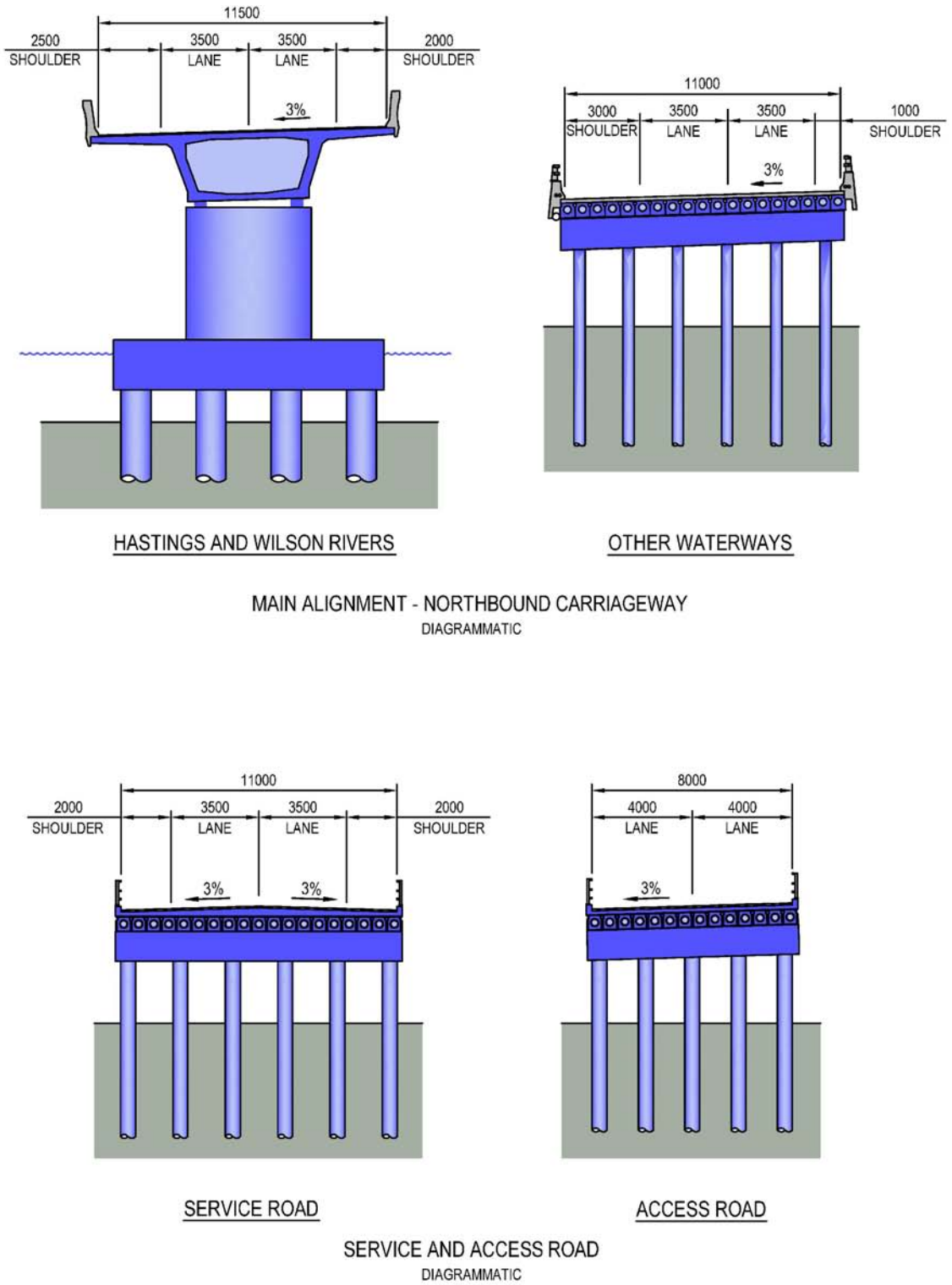


Table 6-5 Typical features of Hastings River bridges

Feature	Value / dimension
Bridge length	570 m
Number of spans	13
Span length	36 m to 45 m (per span)
Vertical clearance	8 m navigable clearance (matches existing Dennis Bridge) 4.6 m (minimum) for Glen Ewan Road
Bridge width	11.5 m
Lane width	3.5 m (x 2 lanes), shoulders – 2.5 m left, 2 m right
Pedestrian facilities	No
Bicycle facilities	On paved shoulder
Other notes	Bridge to be designed with the ability to withstand likely impacts from river vessels and flood events

Note: These values / dimensions are subject to refinement during detailed design.

Wilson River bridges

The Wilson River bridges would be parallel structures approximately 520 metres long, crossing Hacks Ferry Road, the Wilson River, Dalhunty Island and associated State listed wetland areas. The twin bridges would extend from south of Hacks Ferry Road, crossing the eastern tip of Dalhunty Island, to the ridgeline located on the northern bank of the Wilson River. The bridge on the existing Pacific Highway at Telegraph Point would remain in use for the local service road. The bridge crossing over the Wilson River would likely require access to Dalhunty Island for bridge construction activities.

Typical features of the proposed Wilson River bridges are summarised in **Table 6-6**.

Table 6-6 Typical features of Wilson River bridges

Feature	Value / dimension
Bridge length	525 m
Number of spans	12
Span length	36 m to 45 m (per span)
Vertical clearance	8 m navigable clearance (minimum) 4.6 m (minimum) for Hacks Ferry Road
Bridge width	11.5 m
Lane width	3.5 m (x 2 lanes), shoulders – 2.5 m left, 2 m right
Pedestrian facilities	No
Bicycle facilities	On paved shoulder
Other notes	Bridge piers aligned and located to minimise the impact on the State listed wetland on Dalhunty Island (484f) and the northern bank of the Wilson River (484e).

Note: These values / dimensions are subject to refinement during detailed design.

Other bridges

Other bridge proposed include twin bridges over the North Coast Railway, overbridges for grade separated interchanges, traffic arrangements and service roads, vehicular underpasses and watercourse crossings.

A summary of the other bridges along the Proposal is provided in **Table 6-7**. Typical features of overbridges are summarised in **Table 6-8**. Vehicular underpasses would be constructed to provide vehicle access under the Proposal while bridges would be constructed to pass over existing watercourses. The typical dimensions of the vehicular underpass and watercourse bridges would differ from the overpass bridge as they have varying design lengths and requirements. Flood relief structures are discussed in **Section 6.4.15**.

Table 6-7 Other bridges

Location (station)	Bridge	Bridge type	Functional requirement	Width	Typical bridge length
1840	Sancrox Road	Service road overbridge	Span the upgraded highway. Includes pedestrian provision on northern side.	12 m	68 m
4600 - 4900	Fernbank Creek – upgraded highway	Watercourse crossing	Provide the required waterway area.	Twin 11 m	250 m to 275 m
8160	Blackmans Point Road interchange	Service road overbridge	Span the upgraded highway.	11 m	70 m
9120 - 9180	Blackmans Point Road	Service road vehicular underpass	Twin highway bridges to span the proposed service road at the Blackmans Point Road interchange.	Twin 11 m	52 m
11500	Bill Hill Road	Access road overbridge	Span the upgraded highway.	8 m	61 m
17200 - 17290	North Coast Railway	Railway underpass	Twin bridges to span the North Coast Railway.	Twin 11 m	68 m
18040	Haydons Wharf Road half interchange	Service road overbridge	Span the upgraded highway.	12 m	63 m
19660 - 19710	Cooperabung Creek – upgraded highway	Watercourse crossing	Provide the required waterway area.	Twin 11 m	36 m
19670- 19700	Cooperabung Creek access road (east side)	Watercourse crossing	Provide the required waterway area.	8 m	30 m
19670- 19700	Cooperabung Creek access road (west side)	Watercourse crossing	Provide the required waterway area.	8 m	35 m
22145 - 22170	Yarrabee service road	Service road vehicular underpass	Twin bridges to span Yarrabee service road.	Twin 11 m	20 m

Location (station)	Bridge	Bridge type	Functional requirement	Width	Typical bridge length
25320	Mingaletta Road	Service road overbridge	Span the upgraded highway.	11 m	65 m
27390	Wharf Road	Service road overbridge	Span the upgraded highway.	11 m	60 m
28225 - 28270	Smiths Creek – upgraded highway	Watercourse crossing	Provide the required waterway area.	Twin 11 m	35 m
28225 - 28270	Smiths Creek service road (west side)	Watercourse crossing	Provide the required waterway area.	11 m	35 m
29310	Kundabung Road	Service road overbridge	Span the upgraded highway upgrade. Includes pedestrian provision on northern side.	12 m	65 m
30650 - 30690	Pipers Creek – upgraded highway	Watercourse crossing	Provide the required waterway area.	Twin 11 m	41 m
30650 - 30690	Pipers Creek service road (west side)	Watercourse crossing	Provide the required waterway area.	11 m	41 m
30650 - 30690	Pipers Creek access road (east side)	Watercourse crossing	Provide the required waterway area.	8 m	41 m
35300	Maria River State Forest access (Middle Gate Road)	Access road overbridge	Span the upgraded highway.	8 m	62 m
37750 - 37790	Stumpy Creek – upgraded highway	Watercourse crossing	Provide the required waterway area	Twin 11 m	36 m
37730 - 37770	Stumpy Creek access road (east side)	Watercourse crossing	Provide the required waterway area	11 m	40 m

Note: These values / dimensions are subject to refinement during detailed design.

Table 6-8 Typical features of an overbridge

Feature	Value / dimension
Bridge length	60 m to 70 m
Typical number of spans	2 or 3
Typical span length	10 m to 32 m
Vertical clearance	5.3 m (minimum)
Bridge width	8 m to 12 m
Lane width	3.5 m (x 2 lanes), shoulders 2 m left and right
Pedestrian facilities	2.0 m footway (as required)

Feature	Value / dimension
Bicycle facilities	On paved shoulder
Other notes	Protective throw screens to be provided at all overbridges.

Note: These values / dimensions are subject to refinement during detailed design.

6.4.7 Provision for pedestrian and cyclists

No provision has been made for pedestrian access to the main carriageways of the Proposal for safety reasons. No specific provision has been made for cyclists on the main carriageways of the Proposal, however cyclists would be permitted to use the 2.5 metre wide shoulders. Signposting and crossing points would be provided for cyclists at the interchange and traffic arrangement ramps and on- or off-ramps. Cyclists would also be able to use the service road network, which would offer a safer cycling environment due to lower vehicle speeds and traffic volumes.

Pedestrian footways would be provided at the following locations:

- Sancrox Road overbridge (approximately 600 metres south of Sancrox Road).
- Kundabung Road overbridge (at Kundabung Road).

In addition, there would be opportunities for pedestrians to cross the upgraded highway at other overbridges and vehicular underpasses, however no specific provision has been made due to anticipated low volumes of pedestrian traffic.

6.4.8 Bus stops

Due to safety concerns associated with pedestrian movements on or near a high-speed highway, no provision has been made for bus stops along the upgraded highway. Provision has been made for buses to exit the upgraded highway at controlled access points such as interchanges and traffic arrangements, and use the local roads and service road network to pick up school students and other passengers.

6.4.9 Rest areas

Existing rest areas

There are several existing and proposed rest areas located on the Pacific Highway to the north and south of the Proposal. For northbound traffic, there are two rest areas available in close proximity to each other approximately 8.5 kilometres and 12.3 kilometres south of the Oxley Highway interchange. Rest areas are also proposed as part of the Kempsey to Eungai Pacific Highway upgrade to the north of the Proposal.

The existing rest areas within the Proposal area are:

- Southbound opposite Smiths Creek Road at Kundabung.
- Northbound on Bloodwood Ridge in the Maria River State Forest.

The existing rest area at Kundabung is within the footprint of the Proposal. There would be no direct access from the upgraded highway to the existing rest area in the Maria River State Forest. The future of this rest area would be agreed with Kempsey Council and/or Forests NSW.

Proposed rest areas

The Proposal incorporates the construction of new northbound and southbound rest areas in the vicinity of Mingaletta Road (refer to **Figure 6-2l**) to replace the existing rest areas that are to be removed. The location of the proposed rest areas has been selected to best meet the balance between social, environmental and engineering constraints and opportunities. The design of the proposed rest areas would be finalised during the detailed design stage.

The proposed rest areas would be designed to accommodate both trucks (up to B-double size) and cars. These rest areas would provide:

- An area of approximately 500 metres in length and 100 metres in width, including a buffer zone of approximately 20 metres.
- Parking spaces for approximately 20 large trucks to simultaneously park and use the facilities without the need to manoeuvre on entering or exiting.
- Suitable parking and movement for B-double vehicles.
- Cars parking areas separate from truck parking areas.
- Toilet amenities and a picnic area.

Water for toilet amenities at the rest area would be provided from on-site rainwater tanks, supplemented as necessary by water tankers.

6.4.10 Service centres

The RTA has developed a *Stopping Area Strategy*, which is a means of coordinating vehicle stopping opportunities with local facilities as part of the Pacific Highway Upgrade Program.

No service centres are proposed as part of the Proposal. There is an existing service centre located immediately south of the Proposal at the intersection of the Pacific Highway and the Oxley Highway and planning is underway for a service centre adjacent to the South Kempsey interchange immediately to the north of the Proposal.

Existing service stations are located at Telegraph Point and Kundabung. These service stations would be accessed via local roads.

6.4.11 Combined emergency crossover and U-turn facilities

Combined emergency crossover and U-turn facilities are proposed to allow U-turns by the RTA, police and emergency vehicles and for diversion of traffic to the opposing carriageway in the case of an emergency. These facilities would generally be spaced at approximately 2.5 kilometre intervals where interchanges are not available, in accordance with the *Pacific Highway Design Guidelines* (RTA 2005a), as shown on **Figure 6-2a** to **Figure 6-2q**.

U-turn facilities would not be provided for the motorway upgrade, with motorists having to use interchanges and traffic arrangements throughout the Proposal to make a U-turn. However, U-turn facilities would be provided in an arterial upgrade, upstream and downstream of at-grade intersections to provide U-turn opportunities.

6.4.12 Truck stopping bays

Truck stopping bays would be provided at approximately 5 kilometre intervals in accordance with the *Pacific Highway Design Guidelines* (RTA 2005a). The location of truck stopping bays are listed in **Table 6-9**. These truck stopping bays are generally located with emergency crossover and U-turn facilities, as described in **Section 6.4.11**.

Table 6-9 Truck stopping bay locations

Location	Approximate station	Direction
South of the intersection of Hastings River Drive and the existing Pacific Highway	5160 5260	Southbound Northbound
North of Bill Hill Road	11600 11700	Southbound Northbound
South of Hacks Ferry Road	14440 14560	Southbound Northbound
South of Haydons Wharf Road	17560 17660	Southbound Northbound
North of Yarrabee Road	23080 23200	Southbound Northbound
North of Ravenswood Road, adjacent to Maria River State Forest	34440 34560	Southbound Northbound

Note: These locations are subject to refinement during detailed design.

6.4.13 Lighting

A lighting scheme would be developed in accordance with the *Pacific Highway Design Guidelines* (RTA 2005a) during detailed design. The aim of the design guidelines in this respect is to minimise the use of lighting.

The design of the lighting implemented on the Proposal would consider the potential impacts on adjacent landowners. Where technically and economically feasible, the most efficient lighting technology would be used to minimise energy consumption and offsite light spill and glare.

Watercourse lighting on the Hastings River and Wilson River bridges would be installed in accordance with NSW Maritime Authority requirements. This lighting would not be visible to motorists.

6.4.14 Pavement design

Several different pavement design types could be applied to the various parts of the Proposal. Preliminary pavement designs have been developed for the upgraded highway travel lanes, the inner and outer shoulders, on- and off-ramps, and service and access roads based on the *Pacific Highway Design Guidelines* (RTA 2005a).

The type of heavy-duty pavement on the upgraded highway travel lanes would be determined during the detailed design phase, while service and access roads may have different pavement types.

Where the existing Pacific Highway is to be incorporated into the new dual carriageway or would become the local access road, various treatments could be considered. These treatments would be subject to detailed design and depend on the assessed residual life of the existing pavement. Treatments could include options ranging from resealing with fine aggregate to thin asphalt overlays or more substantial pavement restoration or overlays.

6.4.15 Drainage and water quality controls

Drainage

The Proposal crosses the Hastings, Wilson and Maria rivers as well as several creeks and watercourses. The design of the Proposal would generally allow the natural flow regimes to be maintained with transverse drainage provided by bridges or culverts. The Proposal would include a longitudinal system of drains, pits and pipes designed to remove surface water from the travel lanes as quickly as possible. Suitable scour protection would be provided at the inlets and outlets of drainage structures. Surface water management is discussed in **Chapter 12 Hydrology**.

Flood protection

To minimise the increase in water levels during flood events, the Proposal would include flood relief structures on the Hastings and Wilson river floodplains.

The type of structures to be installed in these areas could include pipe culverts, box culverts, small bridge structures or a combination of these. As shown in **Figure 6-2a to Figure 6-2q** the proposed locations are:

- Between station 3900 and station 6600 on the Hastings River floodplain.
- Between station 12150 and station 16500 on the Wilson River floodplain.

The final size, location and type of structure would be refined during the detailed design phase.

The potential flooding impacts and the associated management measures are discussed in **Chapter 12 Hydrology**.

Water quality

The approach to the management of water quality for the Proposal focuses on capturing and treating runoff from the Proposal before it enters the local watercourses. The management measures incorporated within the Proposal respond to the differing sensitivity of the local water catchments and the potential impacts from the construction and operational phases.

Management measures incorporated into the Proposal would include temporary sedimentation basins for the construction phase, a number of which would be converted to provide an operational phase water quality function. The basins would serve to treat both day-to-day runoff from the road, and have adequate capacity to contain a major accidental spill from a traffic crash. The size, shape and location of these basins would be finalised during the detailed design stage and would vary according to local conditions and sensitivity of water catchments.

Further details of existing local water quality and proposed management measures can be found in **Chapter 13 Water quality**.

6.4.16 Fauna passage

A number of fauna passage features, including dedicated fauna underpasses, combined fauna crossings and drainage structures, incidental crossings (such as bridges and other drainage structures), aerial fauna crossings and glider poles, in conjunction with wildlife exclusion fencing, have been incorporated into the Proposal design to reduce the potential for adverse impacts on native wildlife as a result of habitat fragmentation barrier effects and road mortality.

Fauna underpasses

The types of fauna underpasses proposed are described below.

Dedicated fauna underpasses

Dedicated fauna underpasses have been strategically located to align with identified wildlife corridors where possible. These dedicated underpasses would generally be of larger dimensions so as to encourage and facilitate use by a broad range of fauna species, including the koala and larger fauna such as macropods. Permanent floppy top fencing would be installed to direct fauna into dedicated underpasses.

Combined fauna crossing and drainage structures

The culverts required at watercourse crossings would be primarily for hydraulic purposes but would be designed to act as dual-purpose drainage and fauna movement structures. The combined structures aim to supplement the dedicated underpasses and provide further opportunities for fauna movement through the study area and wider locality. The structures comprise box culverts rather than pipes.

The combined culverts would comply with the RTA requirements for the installation of fauna underpasses and associated structures, including consideration of the requirement to provide dry passage, sky lights, appropriate refuge for native fauna and fauna fencing at the detailed design phase. Fauna fencing would most likely be installed in the vicinity of combined crossings where the Proposal traverses areas of key habitat (for example, state forests and nature reserves) and regional corridors. Frog fences and turfed dish drains (or similar) would be established in areas where threatened frogs are known or likely to occur to assist in directing frogs away from the highway and through culverts along creeks or drainage lines.

Measures to facilitate fish and amphibian crossings would be incorporated into the detailed design (where feasible and reasonable) in accordance with requirements in *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003) and *Policy and Guidelines for Fish Friendly Waterway Crossings* (Department of Primary Industries 2003).

Scour protection devices such as rock armouring would be incorporated into the culvert design to provide a gradual transitional level between the ground level and the level of the culvert so that terrestrial fauna can reach and utilise the drainage culverts as fauna underpasses.

Incidental fauna crossings

Incidental crossings comprise pipes and culverts designed for drainage purposes only but that may be used by fauna on occasion. The structures are of smaller dimensions than the dedicated underpasses and combined use culverts. Use of these incidental crossings in many cases would consequently be limited to smaller fauna (for example, small terrestrial mammals and herpetofauna) when and if conditions were suitable (for example, when dry for mammals). These structures would not be designed specifically to facilitate fauna movements.

Bridges would also provide opportunities for incidental fauna crossing, including larger terrestrial mammals.

Example of floppy-top fencing

Fauna exclusion fencing

Fauna fencing would be provided in areas where there are known fauna movement corridors, in state forests and other areas where fauna movement would be considered at risk by the Proposal. Fences would need to be regularly maintained with vegetation removed on either side of the fence so that there is no touching canopy. Permanent floppy-top fencing would be installed, directing animals to fauna underpasses and culverts beneath the highway.

Summary of proposed fauna underpasses

A summary of the proposed fauna underpasses is presented in **Table 6-10** and **Table 6-11**, and the indicative location of proposed fauna crossings is shown in **Chapter 15 Flora and fauna**. Additional information on size and type of proposed fauna crossings can be found in Section 6.3 of the *Flora and Fauna Working Paper* provided in **Volume 2** of this Environmental Assessment.

Table 6-10 Summary of proposed dedicated fauna underpasses

Station	Crossing type	Functional requirement
1620	Dedicated	Provides crossing opportunities for general fauna Links areas of key habitat within sub-regional corridor
2625	Dedicated	Provides crossing opportunities for general fauna Links areas of key habitat to the west with habitat to the east
3605	Dedicated	Provides crossing opportunities for general fauna Links areas of key habitat to the west with habitat to the east
20528	Dedicated	Provides crossing opportunities for general fauna Links vegetation to the east and west that is contiguous with a regional corridor linking Cooperabung Nature Reserve and Ballengarra State Forest
21255	Dedicated	Provides crossing opportunities for general fauna Located in a regional corridor and links key habitat east and west (including Cooperabung Nature Reserve and Ballengarra State Forest)
23325	Dedicated	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
26400	Dedicated	Provides crossing opportunities for general fauna Links vegetated habitat to the east and west
28295	Dedicated	Provides crossing opportunities for general fauna Links extensive areas of key habitat within state forests to the east and west within sub-regional corridor
33390	Dedicated	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor

Note: Locations are subject to refinement during detailed design.

Table 6-11 Summary of proposed combined fauna crossing and drainage structures and incidental crossings

Station	Crossing type	Functional requirement
1020	Combined	Provides crossing opportunities for general fauna Links habitat and vegetation in proximate subregional east-west corridor
1590	Incidental	Provides crossing opportunities for general fauna Links native vegetation in subregional corridor
2605	Incidental	Provides crossing opportunities for general fauna
3585	Incidental	Provides crossing opportunities for general fauna Links native vegetation
4231	Incidental	Provides crossing opportunities for general fauna Links native vegetation
4456	Combined	Provides crossing opportunities for general fauna
4600-4900	Bridge – incidental	Provides crossing opportunities for general fauna
5180	Combined	Provides crossing opportunities for mainly waterbirds, grassland birds, macropods, frogs, reptiles
5540 and 6020	Bridge – incidental	Provides crossing opportunities for general fauna
6283	Combined	Provides crossing opportunities for general fauna
6727	Combined	Provides crossing opportunities for general fauna
7272	Combined	Provides crossing opportunities for general fauna
9209	Combined	Provides crossing opportunities for general fauna Links key habitat in Rawdon Creek Nature Reserve to the west and key habitat in Cairncross State Forest to the east, within a regional corridor
10680	Incidental	Provides crossing opportunities for general fauna Links native vegetation within Cairncross State Forest
11151	Incidental	Provides crossing opportunities for general fauna
11692	Incidental	Provides crossing opportunities for general fauna Located within a regional corridor and links vegetation in Cairncross State Forest to the east and west
12410	Incidental	Provides crossing opportunities for mainly grassland birds, frogs, reptiles
16050	Bridge – incidental	Provides crossing opportunities for general fauna
17175	Bridge – incidental	Provides crossing opportunities for general fauna
17158	Combined	Provides crossing opportunities for general fauna
17708	Multi-use crossing (livestock, vehicles, fauna)	Provides crossing opportunities for general fauna
18623	Incidental	Provides crossing opportunities for general fauna Links native vegetation
18743	Incidental	Provides crossing opportunities for general fauna

Station	Crossing type	Functional requirement
19660-19710	Bridge – incidental	Provides crossing opportunities for general fauna
20050	Incidental	Provides crossing opportunities for general fauna Links native vegetation east and west adjacent to Cooperabung Nature Reserve
20260	Incidental	Provides crossing opportunities for general fauna
21531	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
21791	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
22179	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
23140	Incidental	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
23967	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
24441	Incidental	Provides crossing opportunities for general fauna Links extensive areas of key habitat within a regional corridor
24732	Incidental	Provides crossing opportunities for general fauna Located adjacent to a regional key fauna corridor
25105	Incidental	Provides crossing opportunities for general fauna Located adjacent to a regional key fauna corridor
25427	Incidental	Provides crossing opportunities for general fauna
25706	Combined	Provides crossing opportunities for general fauna
26383	Incidental	Provides crossing opportunities for general fauna
26785	Combined	Provides crossing opportunities for general fauna Only limited connectivity to the west
27510	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat within state forests to the east and west within sub-regional corridor
28225-28270	Bridge – incidental	Provides crossing opportunities for general fauna Located on edge of subregional corridor
28673	Combined	Provides crossing opportunities for general fauna Located near subregional corridor
29608	Incidental	Provides crossing opportunities for general fauna
30077	Incidental	Provides crossing opportunities for general fauna
30660	Bridge – incidental	Provides crossing opportunities for general fauna
30957	Combined	Provides crossing opportunities for general fauna Located near regional corridor
31107	Combined	Provides crossing opportunities for general fauna Located near regional corridor

Station	Crossing type	Functional requirement
31887	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River and Ballengarra state forests within regional corridor
32357	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River and Ballengarra state forests within regional corridor
32662	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River and Ballengarra state forests within regional corridor
33103	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor
34086	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor
34714	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor
35727	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor
36356	Combined	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor
37730-37790	Bridge – incidental	Provides crossing opportunities for general fauna Links extensive areas of key habitat in Maria River State Forest within regional corridor

Note: Locations are subject to refinement during detailed design.

Note that only structures greater than 1.2 metres in diameter and height are identified in **Table 6-10** and **Table 6-11**, although smaller structures are also likely to provide fauna passage for amphibians, small ground-dwelling mammals and reptiles. Existing structures such as the Maria River bridge are also not included. The precise location, size and design of structures would be further refined in consultation with DECCW during the detailed design phase.

Aerial fauna crossings

A combination of rope ladders and glider poles is proposed for arboreal fauna which do not utilise underpasses. Indicative ranges where these aerial fauna crossings would be considered are:

- Rope ladders:
  - Station 1000 to 1500.
  - Station 3500 to 4500.
  - Station 7250 to 8250.
  - Station 9250 to 10000.
  - Station 11150 to 11750.
  - Station 20750 to 21250.

  - Station 24000 to 24500.
  - Station 33500 to 34000.
  - Station 35800 to 36400.
- Glider poles:
  - Station 10100 to 11150.
  - Station 11700 to 12225.
  - Station 22600 to 23200.
  - Station 25075 to 25425.
  - Station 34700 to 35775.

The potential for widening the median of the Proposal at these locations where it is reasonable and feasible to do so would be further investigated in consultation with relevant government agencies and affected landowners during the detailed design phase.

The actual number, location and design of rope ladders and glider poles would be determined at the detailed design phase in consultation with DECCW. Generic design guidelines for these crossing structures can be found in Section 6.3.2 of the *Flora and Fauna Working Paper* provided in **Volume 2** of this Environmental Assessment.

Further details on the provision of fauna passage are provided in **Chapter 15 Flora and fauna**.

6.4.17 Geotechnical issues

Preliminary geotechnical investigations have been undertaken to provide information for the development of the Proposal. These investigations identified the soils types along the Proposal's alignment and provided information to assist in:

- Developing soft soil treatment techniques for embankments and bridge abutments.
- Establishing batter slopes in deep rock cuttings.
- Developing bridge designs throughout the Proposal.
- Identifying suitability of excavated materials at cuttings for re-use in embankments.

Section 21.3 provides further detail on the geotechnical investigations undertaken for this Environmental Assessment. Further investigations would be undertaken as part of the detailed design phase.

Cutting and batter slopes

Table 6-12 summarises the key features of embankment batter slopes based on the geotechnical investigations undertaken for the Proposal.

Table 6-12 Embankment batter slopes

Description	Cutting slope (horizontal:vertical)	Fill batter slope (horizontal:vertical)
Typical main alignment	2:1	4:1 (Less than 2.5 m height)
Deep cut or fill	2:1 with 4.5 m benches at 7 m maximum vertical spacings Min 1.25:1 in areas of restricted space	2:1 (More than 2.5 m height) 4.5 m benches at 10 m maximum vertical spacing
Deep cut (Cooperabung Hill)	0.75:1 with 4.5 m benches at 7 m maximum vertical spacings 2:1 at top of cutting, above highest bench	-
Service and access roads	2:1 with 3 m table drain	4:1

Earthworks

The preliminary geotechnical investigations indicate that material sourced from excavations is likely to fall into one of two categories:

- South of the Wilson River, the material excavated is only expected to be suitable for use as general fill.
- North of the Wilson River the material is likely to be suitable for use as general fill as well as for select fill material or upper zone formation material.

There are a number of areas of significant excavation, which would provide material for use in other areas of the Proposal. The main cuttings supplying material are located at:

- Cooperabung Hill – cuttings up to 31 metres in depth.
- Maria River – cuttings up to 13 metres in depth.

Both of these areas of cuttings are in the northern part of the Proposal area and are expected to produce material that is suitable for use as select fill or upper zone formation.

The final earthworks balance for the Proposal would be assessed following further geotechnical investigations and preparation of the detailed design. The earthworks balance would be influenced by the possible staging of the Proposal, which is discussed further in **Section 7.3**. The earthworks for the Proposal for the motorway standard are generally balanced across the full length, with most of the cut material being hauled to the south. Much of this material would be utilised for the floodplain embankments in the southern half of the Proposal. If the final staging option selected involves construction of arterial standard only initially for Sections B (north of Haydons Wharf Road), C and D, or construction of Sections B (north of Haydons Wharf Road), C and D at a later date, there could be a need to source fill for construction of Sections A and B, either from within the Proposal boundary or from other sources.

Further discussion regarding potential sources of construction materials from within and external to the Proposal is provided in **Section 7.5**.

6.4.18 Urban and landscape design

Urban and landscape design considerations have influenced the Proposal's route selection and engineering design. Urban design and landscape components of the Proposal have been developed with the aim of maintaining the visual character of the surrounding landscape wherever possible. Details of the urban and landscape design strategy are provided in **Chapter 17 Visual amenity and urban design**.

6.4.19 Utility relocation

A number of existing utility relocations would be required as part of the Proposal. These utilities include telecommunications (including fibre optic cables), low and high voltage overhead electricity lines and water mains. Utilities would generally be relocated outside of the Proposal boundary, which has been established to minimise property acquisition, clearing and other environmental impacts. The relocation of these utilities would be finalised as part of the detailed design in association with the utility provider. A summary of the major utilities impacted by the Proposal is provided in **Table 6-13**.

Table 6-13 Major utilities within the Proposal area

Utility class	Authority	Location	Description
Communications	Telstra and Optus	Throughout	Trunk optic fibre and co-axial and copper networks, distribution copper networks
Electricity	Country Energy	Throughout	66 kV, 33 kV and low voltage
Water	Port Macquarie-Hastings Council	Section A	150 mm water main